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Radical Treatment of Trifacial Neuralgia —*Adson*

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Classification of Dental Schools

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BURTON LEE THORPE, M.D., D.D.S., Kansas City, Missouri
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Original Communications

NEUROLOGICAL COMPLICATIONS OF DENTAL ORIGIN AND THEIR SEQUELAE

By ALBERT D. DAVIS, B.Sc., M.D., D.D.S., Omaha, Nebraska

(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

NEUROLOGICAL complications of dental origin are many and varied and the sequelae following in their wake often lead to serious afflictions. In order to fully grasp the true significance of the subject, it seems best to briefly review the cranial nerve most often affected in complications of dental origin, thus establishing a working basis, whereby symptomatology may be explained.

The close association of the fifth nerve, with other cranial nerves and ganglia, its particularly wide distribution and combined function, renders disturbed function difficult of interpretation. In the development of the fifth nerve so many factors have entered to change its course and distribution that in man we find a complicated mechanism, very efficient and well balanced in health, and yet so subject to insult.

The fifth nerve of vertebrates belongs to that group of cranial nerves known in the primitive vertebrate type as branchiomeric nerves, the other members of the series being the seventh, ninth and tenth. These four nerves take care of the innervation of the musculature and surfaces of both the skin and mucous membrane of the pharynx. This musculature, although striated, differs embryologically from the general skeletal musculature of the body, and physiologically it is at first more closely related to visceral functions than the latter. The motor nuclei from which rise the motor fibers of these branchiomeric nerves, form a more or less continuous column of motor cells in the brain stem, distinct from that of the twelfth, sixth, fourth and third. The components entering into these nerves are, in those forms having the primitive pharynx of

the lower fishes, of three kinds, namely: sensory, from the skin, sensory from the mucous membrane, including taste buds, and motor above mentioned.

Any modification in any segment of the pharynx is, of course, reflected in the composition of the nerves. Such modification is profound in connection with the field of innervation of the trigeminal. That is to say, the mouth and jaws exist as such in the lowest vertebrates, and not as a branchiomeric cleft and arch with which we are homologizing them.

Moreover, this region lies anterior to the entodermal part of the pharynx, thus excluding the trigeminal from participation in the innervation of a truly visceral mucous membrane. On the other hand, the ectodermal, or somatic surfaces are enormously extended on account of the extensive development of the snout and the two ectodermal impocketings, the external nasal cavity and the buccal cavity, the latter bearing the teeth. It is not surprising then, that visceral fibers such as those of taste, found in peripheral rami of the trigeminal have been found to belong to the other branchiomeric nerves, seven and nine, and that an analysis of the trigeminal roots proximal to the ganglion, shows an absence of such fibers.

It might be of further interest to add that the modification of the rest of the primitive pharynx through the phylogenetic series shows its highest expression in man, where the disappearance of the gills, closing of the clefts and consequent shortening of the pharyngeal region almost obliterates the cutaneous or somatic field contiguous with that of the first spinal nerve. Of course, this very process of telescoping the pharyngeal segments has resulted in overlapping of deeper structures (which have been retained with their original innervation) and a confusing anastomsis of peripheral rami.

The fifth nerve arises by two roots near the upper border of the pons Varolii. The smaller (anterior) motor root takes its superficial origin as a mass of three or four bundles near the sensory root, but separated from it by a few transverse fibers of the pons.

The large sensory root (posterior) consists of various bundles of fibers, varying from seventy to a hundred, and takes its superficial origin near that of the motor root. The deep origin of the sensory root is from a nucleus just below the floor of the ventricle and just internal to the sensory root nucleus.

The two roots pass forward through an oval opening (Cavum Meckelii) in the dura mater, on the superior border of the petrous portion of the temporal bone, where the fibers of the sensory root form a large semilunar shaped ganglion (Gasserian). The motor root passes beneath the ganglion without having any connection with it and joins outside the cranium with one of the trunks derived from the ganglion.

From the Gasserian ganglion axones pass backward to the brain through the sensory fibers which become consolidated into the large sensory root. This root passes through an opening in the dura mater just beneath the attachment of the tentorium cerebelli to the posterior clinoid process and, coursing backward, enters the brain stem on the lateral surfaces of the pons, where a conspicuous group of bundles mark its superficial origin. Below this origin but directly in line with it, the superficial origins of the facial and auditory nerves are found, while just above is the superficial origin of the motor root separated from the sensory origin only by a small bundle of pontine fibers belonging to the middle cerebellar peduncle.

Entering the tegmental portions of the pons the sensory fibers soon come into relation with the trigeminal nucleus which extends from the middle of the pons through the entire length of the medulla and into the spinal cord as far down as the level of the second cervical segment, where it becomes continuous with the substantia gelatinosa of the

cord. The rounded upper end of this club-shaped column is the sensory nucleus of the fifth nerve, although it embodies only a small part of the reception nucleus.

As the sensory fibers approach this column, they divide into ascending and descending branches. The descending branches become consolidated into a compact bundle, closely embracing the lateral surface of the column of gray substance. The ascending fibers penetrate the sensory nucleus and the substantia gelatinosa and end in arborizations around the neurones of the reception nucleus. Due to collaterals and fibers given off during its descent into the cord, the spinal root gradually becomes smaller and more superficial until it disappears entirely at the second cervical segment.

In contrast to the median location of the nucleii of origin of the third, fourth, sixth and twelfth, the deep origin of the motor part of the trigeminal nerve includes groups of cells that lie at some distance from the raphe, and fall into series with the laterally placed nucleii of the motor parts of the other mixed cranial nerves (seven, nine and ten).

The largest contingent of the motor fibers arise as axones from the neurones within the chief motor nucleus which lies in the upper part of the pons close to the median side of the sensory nucleus. A few fibers cross over beneath the floor of the fourth ventricle and join the motor root of the opposite side.

A second constituent of the motor root includes fibers that arise from cells lying within the lateral part of the gray matter surrounding the aqueduct of Sylvius, and is known as the mesencephalic root of the fifth. During its course downward, the mesencephalic root is joined by numerous fibers which have their origin in pigmented cells of the same and opposite sides.

The fibers from all these sources become consolidated into the motor root, the superficial origin of which lies just above that of the sensory root. The motor root follows the same course as the sensory root, to and through the dura mater, passing beneath the Gasserian ganglion to become exclusively an integral portion of the mandibular division of the trigeminal nerve.

The cortical origin of the motor root, located in the lower third of the central convolution, gives rise to fibers which pass through the corona radiata, enter the internal capsule with the pyramidal tract and make their first synapses with the chief motor nuclii in the dorso-lateral part of the tegmentum of the pons. Most of the fibers cross about the level of the posterior corpora quadrigemina. From here the second motor neurones pass through the foramen ovale with the inferior maxillary division and are distributed to the muscles.

The sensory receptors of the trigeminus are widely distributed over the face, the mucous membranes of the oral and nasal cavities, sinuses, etc. Affections of this portion of the fifth nerve are often combined with motor reactions.

As a result of this combination and wide distribution, intricate and complex symptoms occur.

The chief sensory impulses pass from these roots to secondary neurones through the medial lemniscus to the opposite side and end in the thalamus where tertiary neurones carry them on to the sensory areas of the brain.

The Gasserian ganglion is an imimportant complex of nerve cells and fibers lodged in a depression known as Meckel's space, near the apex of the petrous portion of the temporal bone. It is of somewhat crescentic form with the convexity turned forward, and lies in close relationship with the cavernous sinus and the internal corotid artery. Three large trunks representing the three divisions of the nerve are given off from the anterior portion and in addition are a few filaments to the dura. The ganglion receives filaments from the corotid plexus of the sympathetic.

The three divisions of the trigeminal

nerve are the ophthalmic, maxillary and mandibular. The latter two divisions and their branches are those which are affected by so many of the complications arising from dental defects.

The ophthalmic division is the smallest of the three, is purely sensory and supplies the upper eyelid, the conjuctiva, the eyeball, the lachrymal gland, caruncle and sac, root and anterior portions of the nose, the frontal sinus, forehead and anterior part of the scalp.

The maxillary division is intermediate in size, purely sensory and supplies the lower eyelid, the cheek, anterior temporal region, side of the nose, upper teeth, upper lip, and the mucous membrane of the nose, lip, maxillary sinus, nasopharynx, posterior ethmoid cells, soft palate, tonsil and roof of mouth. Leaving the cranium by way of the foramen rotundum, it transverses the sphenomaxillary fissure where it occupies the infraorbital groove and canal. It then emerges on the face by passing through the infraorbital foramen where it breaks up into fan-like terminals.

The mandibular division is the largest of the three divisions and is a mixed nerve. Its sensory portion is larger and arises from the lower portion of the gasserian ganglion. The motor element is a direct continuation from the motor root of the trigeminal. The two parts do not unite until they emerge from the skull through the foramen ovale.

The sensory portion supplies the skin of the side of the head, the auricle, the external auditory meatus, lower portions of the face, lower lip, mucous membrane of the mouth, tongue, and mastoid cells, the salivary glands, lower teeth and gums, temporomandibular articulation and dura mater.

The motor portion supplies the muscles of mastication, anterior belly of the diagastric, mylohyoid, tensor palati and tensor tympani muscles.

The ganglia connected with the fifth nerve are to be considered as relay stations whereby impulses coming in over various nerve trunks may be either shunted off to other nerves or pass directly through the ganglia to the brain stem. It is interesting to carefully study the origin of these ganglia and to understand their connections in order to grasp the full significance of some of the various disorders affecting them. These ganglia are, as a rule, formed from cell masses which develop during the formation of the nervous system and follow the paths of the nerve trunks to their ultimate destination.

In pig embryos the neural crest becomes differentiated into ganglionic masses at the fifth to sixth millimeter stage. At this time the anlage of the Gasserian ganglion appears as a somewhat irregular mass of cells lying in close proximity with the lateral surface of the anterior region of the rhombencephalon.

During development this mass of cells is shifted ventrally until it lies laterally to the rhombencephalon in the region of the pons.

At the eighth millimeter stage in the pig, the Gasserian ganlion has already assumed its crescentic form and fibers of the sensory root have penetrated the wall of the rhombencephalon.

During this early development the Gasserian ganglion is not limited peripherally, but has cells pushed out into the proximal parts of the nerves arising from it so that in these regions it is quite impossible to determine the limits of this ganglionic mass. Similar cells may be observed associated with the fiber bundles throughout the entire length of the nerve trunks, both sensory and motor. It is probable that these cells advance peripherally along the fibers of all three divisions of the trigeminum.

These cells are migrant cells and are identical in this early developmental stage with the majority of the cells in the cerebrospinal ganglia and the mantle layer of the neural tube. It has been suggested by Johnston (1908) and others, that the sensory ganglion cells belonging to the mid-brain and the most

oral part of the hind-brain become included in the wall of the neural tube instead of becoming incorporated in the Gasserian ganglion. It is these cells that are supposed to form the mesencephalic root of the trigeminal nerve, their processes extending candalward beneath the central gray substance to join the main sensory trunk of the nerve at its point of entrance into the wall of the tube.

The mesencephalic root of the fifth nerve is now considered to be the muscle sense portion of the nerve and has its ganglion cells in both the mid-brain and in the Gasserian ganglion.

The ciliary ganglion in selachians seems to be formed in part from the thalmic nerve, which is a ganglionic anlage and is closely related, in early embryonic development, with both the second and third pair of cranial nerves. In the chick a part of the ciliary ganglion is derived from the neural tube and a part from the optic nerve. This double origin of the ciliary ganglion is of interest since there is still an unsettled question as to whether the excitatory neurones in the sympathetic system have their origin as modified spinal ganglion cells or directly from indifferent ectodermal cells.

Both the sphenopalatine and submaxillary ganglia are probably derived from the Gasserian ganglion, but, on account of their communicating fibers with the geniculate ganglion of the facial, they may have migrated via the great superficial petrosal.

Knowing the extensive ramifications of the fifth nerve and the extremely high percentage of individuals affected with diseased teeth supplied by this nerve, it is strange that there are not more numerous cases of neurological complications of dental origin. The symptomatology of lesions of the fifth nerve is diverse as it has both a sensory and a motor part, and has many synaptic junctions with cranial, spinal and vegetative nerves.

Carious teeth, as a rule, respond so quickly to thermal shock that localization of pain in the region affected forces the patient to the dentist for correction before untoward results accrue. Sometimes, however, these teeth are neglected and serious neuritis results. Barring the passage of a stone in the gallducts or the ureters there is no pain that may be comparable to that of an acute pulpitis. Immediate relief is usually obtained by the application of suitable drugs, but the problem remains as to the proper care of these teeth afterward. If these teeth go on to the formation of an abscess or if the canals are filled and a diseased condition develops at the apex, causing serious injury to the health of our patients, *we* are responsible.

Calcarious degenerations in the pulp due to irritation or disease sometimes cause obscure and baffling neurological symptoms. According to Cryer, pulp stones are one of the most common causes of trigeminal neuralgia.

Malposed teeth or those in crowded arches causing backward pressure upon the large branches of the nerve, teeth with exposed and extremely sensitive gingival areas are all contributing factors in the dental origin of neurological complications.

Impacted teeth sometimes cause severe complications when their existence is least suspected and only discovered by a roentgenogram. The symptoms of impacted teeth are usually both local and general. The local symptoms are: dull pain occurring during relaxation, a sense of pressure on neighboring teeth and tenderness over the region of the impaction. These may be entirely absent. The general symptoms are headaches, neuritis, and even more severe symptoms such as acute manias have been reported. These general symptoms may in no way seem to be related to these impactions, yet entirely disappear upon the proper removal of the affected teeth. This may be readily understood if we but recall our consultation with the family physi-

cian at the bedside of a teething infant in convulsions. The nervous system of the infant is not as highly organized as that of the adult, and no doubt there is a diffusion of the impulse coming into the sensory areas of the brain, causing a hyperexcitation of the nervous system, ending in eclampsia.

Improper surgical methods employed in the removal of these impacted teeth oftentimes cause more complications than do the teeth themselves. In the lower jaw where the impacted tooth overlies the roof of the mandibular canal, the usual practice of elevating the tooth distally in order to remove it is to be condemned. Tipping the crown distalward forces the root of the tooth downward and forward, oftentimes breaking the wall of the mandibular canal.

Not only is there a primary injury to the nerves and vessels within the canal, but as healing occurs, scar tissue forms and adhesions occur, cutting down the blood supply and causing nerve irritation.

This is only one of the many sequelae following in the wake of improperly operated impactions. Sometimes the nerves themselves are severed, making a difficult case to handle. I have seen several cases where the chorda tympani has been divided by a misguided operator in his zeal to remove the root of a broken off lower third molar. The suffering of these unfortunate patients is pathetic, and they wander from specialist to specialist in a vain hope for relief.

The close connection and communication between the corotid, facial and meningeal plexuses with the superior cervical ganglion and the vagus nerve, may explain many of the systemic disorders resulting from dental impactions. Not infrequently, impacted teeth become encysted, followed by degeneration of the cystic wall and destruction of the major portion of the mandibular nerve.

The fifth-nerve, coursing through bony channels, over resisting structures and further on, with its constant exposure in the face and nasopharynx to injury and infection, makes it especially liable to traumatic and irritating conditions.

Neuralgia is the result of some irritation, directly or indirectly applied to a nerve characterized by pain which follows the nerve trunk or its branches and tending to shift from place to place. Neuralgia may be an expression of a function disturbed locally, systematically or both. The pain is not constant and complete absence of pain between paroxysms is the rule. The skin over the area of pain is sensitive to touch, but deep pressure may relieve the pain. Movement of the muscles of mastication during an attack of neuralgia intensifies the pain, and motion of any kind, even though slight, may excite severe stabbing pain. During and between paroxysms neuralgic areas present nerve tenderness, most marked at such points where the nerve overlies bone or is superficial. Irritation of one branch of a nerve may induce neuralgia in another nerve, closely related. The muscles and blood vessels are affected in some cases as shown by the spasmodic muscular contraction and the blanching and flushing of the affected area.

Localization of the pain usually points to the particular branch of the nerve affected, but the wide distribution and fluctuating character of the pain may obscure the cause.

In neuralgias of the first ophthalmic division, there is pain in the supraorbital region radiating over the brow and even to the vertex. The eyeball is frequently tender and may be the seat of pain. Tender points are usually found over the lower margin of the nasal bone, upper lid, and supraorbital notch. The left side is more often affected. Neuralgias of the second or superior maxillary division cause pain which is felt over the cheek in the triangle formed by lines, between the orbit, the mouth and the wing of the nose, with tender points at the lower border of the nasal bones or malar process and at the infraorbital foramen or cuspid tooth.

When the mandibular division is affected, pain courses along the jaw, tongue and corresponding portions of the face, and by its auricular branches extends to the zygomatic and parietal regions. Pain in neuralgias of the fifth nerve is usually lancinating in character, intense in degree and may cause excruciating torture. When the attacks are severe they may cause vasomotor and secretory disturbances such as lachrymation, salivation and mucous discharges from the nose. The tongue, lip, brow or entire side of the face may be swollen and oedematous. Hyperalgesia is often so intense that mastication or any motion may provoke a paroxysm of pain. Herpes or eruptions may occur if the histological changes have taken place in the nerve or its nucleus.

The patients who are affected by trigeminal neuralgias are indeed unfortunate. Usually of dental origin, but as a rule unresponsive to the correction of dental defects these neuralgias present one of the most difficult problems the profession encounters. In a vain hope for relief oftentimes many or even all of the teeth are lost. This only brings disfavor and criticism on an honored profession, but it should be a stimulus for further knowledge.

Tic douloureaux is a form of neuralgia occurring in middle or advanced life, usually severe in its symptoms and obstinate in its course. It is characterized by intense, darting, unilateral pains, which usually start in the upper lip and by the side of the nose. From here they radiate through the teeth into the eye, or over the brow, head and temple. The pains come in paroxysms, lasting for a few minutes, during which the face is flushed and secretory disturbances are present. The attack lasts for a few minutes then gradually lessens. The branches most often involved are the superior and the inferior maxillary. Examination rarely reveals any objective trouble. The disease is usually a degenerative one and is due to irritative and atrophic processes in the nerve and its ganglion. The arteries supplying the nerve often undergo the changes of endarteritis, their caliber is much lessened and the nerve cannot get its proper supply of blood. It would seem then that tic douloureux may be considered as a form of trigeminal angina.

Medical treatment may be tried using nitroglycerine in doses of 1-200 gr. every two hours. Crystalline aconita, gelsemium etc., are useful.

The common practice of extracting the teeth almost always results in failure to cure and ought not be undertaken without good reason. Massive doses of strychnin for patients who may be hospitalized sometimes gives relief. Opiates are to be avoided. Surgical removal of the nerve at a point as deep as possible is the only operation to be seriously considered and while there may be a recurrence in six months to five years, the alleviation of suffering even for so short a time is worth while.

Resection of the second and third nerve roots, as devised by Hartley and later modified by Abbe, gives relief. Alcoholic injections are, on a whole, rather disappointing and extremely dangerous in unskilled hands.

Trigeminal paraesthesias are characterized by peculiar disturbances of numbness, thrilling or formication along the course of the nerve. The sensation may be nearly constant and is excessively annoying, although actual pain never occurs. It is regarded as an abortive forms of neuritis.

During the past few years focal infection has been recognized as assuming tremendous importance as one of the great provocative causes of mental disease.

Especially has there been an almost generally accepted belief that foci of infection occurring around the root ends of teeth, were responsible for certain types of mental disturbances. Toxic psychoses, with various degrees of mental changes,

have been entirely relieved by the proper removal of foci of infection. Disappointing in the extreme, however, have been those cases in which simple extraction has aggravated a condition already existing.

If the neurological complications occur as a result of foci of infection thorough eradication of the diseased tissue as well as the offending teeth must take place before cures will result.

The statistics from the dispensaries of some of the school children whose mouths have been cleared of focal infection show unbelievable percentages in increased mentality. If these statistics are true, it is less difficult to comprehend the importance of focal infection in mental disorders.

Every year research work is being carried on in neurology and the diseases of the nervous system. We, as dentists and oral surgeons are dealing constantly with nerves most often affected by disease and injury. It is then our duty to study and prepare ourselves that we may recognize, care for, and prevent neurological complications of dental origin and their sequelae.

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THE RADICAL TREATMENT OF TRIFACIAL NEURALGIA

By ALFRED W. ADSON, M.D., B.Sc., M.A., M.Sc., F.A.C.S., Rochester, Minnesota

(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

TRIFACIAL neuralgia is a disease of the Gasserian ganglion; its symptoms are distinctly different from those of the usual neuralgias of the face caused by dental caries and sinus infections. The disease usually begins in middle life. The attacks appear periodically, each one increasing in severity and duration until pain is more or less constant. It does not disappear spontaneously, neither is it relieved without definite surgical procedure. It has been noted, in treating five hundred five cases at the Mayo Clinic, that deep alcohol injection of the main branches of the Gasserian ganglion gives definite relief for a time, but the radical operation, that is, division of the posterior sensory root, is imperative in order to secure instant and permanent relief.

The cause of trifacial neuralgia is still unknown. Certain observers have believed it to be due to ascending neuritis from dental caries, others to a de-

generative change in the Gasserian ganglion, and still others have believed it to be due to sclerosis in the ganglion. In contradistinction to this it is also believed that none of these conditions exist since it has been impossible to demonstrate them either grossly or microscopically.

The belief that trifacial neuralgia is due to infection of the ganglion or is the result of infection elsewhere in the system cannot be excluded. I have seen patients with more or less constant neuralgic pain in the ophthalmic branch following herpes ophthalmia, which was relieved by division of the posterior sensory root. On the other hand, I have never seen patients with trifacial neuralgia cured by the removal of foci of infection. However, I believe that it is fair to assume that the disease must be the result of a previous infection, because infections have been demonstrated in the ganglion in intercostal neuralgia associated with, or following, herpes zoster, because multiple sclerosis is supposed to be due to an infection, and also, because the central nervous system changes of syphilis are the result of *Treponema pallidum.*

Symptoms

Trifacial neuralgia usually occurs at about the thirty-fifth year; it may occur much earlier, and occasionally much later in life. The attacks at first are mild, simulating toothache, but they increase in severity and duration. Not infrequently a patient presents himself to his physician complaining of a tooth or of a sinus; he is quite sure that if the local trouble were removed the pain would subside. The attacks of pain continue, however, even after one or more teeth have been removed or the sinus has been drained and irrigated. The attacks of pain are brought on by external irritation, such as washing the face, cleansing the teeth, chewing, swallowing, talking, and even exposure to air currents. At first the pain comes only during the waking hours, not at night unless the patient awakens, and differs from pain caused by an infected tooth or sinus which remains more or less constant regardless of sleep, and generally prevents sleep. Trifacial neuralgic pain is described as sudden, severe, sharp, shooting, lancinating, and excruciating; some patients compare it to an electric shock through the face, and others to the jabbing of a red-hot poker into the cheek or jaws. The attacks are of short duration, lasting from a few seconds to a minute or two and often during the paroxysm the face and eyes become congested, tears overflow, and patients resort to various contortions in an effort to obtain relief, such as chewing, rubbing the face, stooping forward, and pressing the cheek.

It is interesting to know that irritation of the trigger zones is associated with the onset of the attacks. For instance, a patient may have neuralgia of the superior maxillary division with a trigger zone on the chin which, if touched, will start the paroxysm in the maxillary division; or the trigger zone may be at the angle of the nose as in mandibular division neuralgia. Trifacial neuralgia is more prone to occur in the third and second divisions than in the ophthalmic division. As a rule, only one branch is affected at the onset of the disease, but as it progresses, the other branches, including the ophthalmic division, become affected; however, the ophthalmic division is not so commonly affected as are the superior maxillary and mandibular divisions.

In one case of double neuralgia, the trigger zone was on the opposite side. Usually one side of the face only is affected, but occasionally (in about three per cent of cases) the neuralgia is double with a history of more severe pain on the side on which it began, and of comparatively short periods between onsets. It is also of interest that patients suf-

fering for several years from unilateral neuralgia will not experience double neuralgia.

Discussion of Mayo Clinic Cases

A review of the records at the Mayo Clinic shows that of five hundred five patients suffering from trifacial neuralgia registered since 1910, two hundred seventy-five were males and two hundred thirty females. In three hundred twenty-seven of the cases the right side only was involved, in one hundred sixty-seven the left side only, and in eleven cases both sides were involved. The youngest patient seeking relief was twenty-two years of age, and the oldest was eighty-three. The average age of this group of patients was fifty-four and one-half years, and the average duration of symptoms was approximately eight and one-half years. Twelve patients had chronic nephritis associated with trifacial neuralgia, nine had diabetes, eight had syphilis, fifty-one had symptoms referable to cerebral arteriosclerosis, thirty-one had sclerotic changes of the brain and cord, forty-one had migraine, one had intercostal neuralgia, and seven had sciatica.

The ophthalmic division alone was involved in three patients, the superior maxillary division alone in eighty-three, the mandibular division alone in one hundred seven, the first and second divisions in forty-four, the first and third divisions in four, the second and third divisions in one hundred eighty-one, the first, second, and third in seventy-seven; no record was made of the division involved in six.

One thousand five hundred seventy alcoholic injections were administered during the course of treatment of these patients, an average of three and five-tenths injections for each patient. The average period of relief from pain was seven and seven-tenths months. Besides the alcoholic injections, one hundred twenty-two avulsions of peripheral nerves were performed for palliative purposes. In two hundred twenty-six cases teeth were removed, and in fifty-one cases palliative operations on the nose, throat, and mouth were performed. A summary of the measures introduced for palliative relief reveals a total of one thousand nine hundred sixty-nine palliative operations, performed either by referring physicians, or in the clinic. Aside from temporary relief following alcoholic injection and avulsion of the peripheral nerve, very little has been accomplished, despite the large number of palliative operations performed. No material relief was obtained from the removal of teeth nor from the fifty-one nose and throat operations; in some instances there was a subsidence of the attacks, but the period of relief was more likely to be coincident to the natural interval of quiescence common to the disease, since the neuralgia returned with its usual regularity. Alcoholic injections and peripheral nerve avulsions, if properly carried out, break attacks and prolong the quiescent period.

With the institution of the radical operation, or division of the posterior sensory root fibers, the patient is afforded instant and permanent relief. We have performed the radical operation in two hundred eight cases, and alcoholic injections have been given in two hundred ninety-seven; this group represents many patients who came for treatment prior to encouragement of the radical procedure, patients who were too feeble to stand the shock of surgery, and patients who were under observation and were advised to have two or three injections before submitting to the radical operation. Of the patients who were subjected to the radical operation, one had nephritis, four had diabetes, three had syphilis, twenty-three had cerebral sclerosis, eighteen had sclerosis of the brain and cord, twenty-nine had migraine, and three had sciatica.

Of the two hundred eight operations performed, one was a Hutcheson operation, fifteen were ganglionectomies, forty-two were avulsions of the entire posterior

root, twenty-two were divisions of the sensory root by partially cutting and partially avulsing the root, and one hundred twenty-eight were cutting of the root sharply, posterior to the crest of the petrous bone. The motor root was preserved in twelve consecutive patients, the last twelve operated on. I believe that the ideal operation for trifacial neuralgia is cutting the root on the crest of the petrous bone, and preserving the motor root, since no more time is required for this procedure, and paralysis of the pterygoid, temporal and masseter muscles is prevented.

Since the use of the illuminated retractor, the technic of avulsing the posterior root has been very much more accurate. Three patients operated on previous to its employment had recurrences and on re-operation, it was found that the sensory fibers had been left, accidentally. The retractor exposes the ganglion, the posterior root, and the dural opening above the petrous bone as well as the entire region involved.

In addition to the two hundred eight cases of trifacial neuralgia we have had five atypical cases in which the posterior root was divided. Two of these patients had pain following herpes ophthalmia; both were relieved following operation. In one the posterior root was partially divided and the ganglion and the third branch were resected without relief from pain. In two patients the posterior root was divided without relief.

One hundred and seventy-six of the two hundred eight patients obtained instant relief. Twenty-two of the patients were relieved from the typical pain of trifacial neuralgia, but the administration of nerve sedatives and symptomatic treatment were necessary. Eighteen of these patients became well subsequently; two complained of pain in the eye, and two had syphilis of the central nervous system. This group of twenty-two cases is especially interesting, since the course and severity of the neuralgia had deranged the nervous system.

The mortality of operations for trifacial neuralgia is not so great as in abdominal surgery. In many instances patients operated on for trifacial neuralgia are past sixty years of age. Of the last one hundred sixteen patients operated on at the Clinic, three died. Death in one case was due to diabetes, and in the other two cerebral arteriosclerosis. One patient developed hemiplegia on the affected side, with thrombosis of the vessels and softening of the brain on the opposite side.

Records have been quoted in which a large number of patients have been operated on without a fatality, but a greater surgical risk is warranted in patients with severe neuralgia which cannot be relieved by either alcohol injection or peripheral nerve avulsion. Radical operation is justifiable in such cases when the mortality is not greater than two per cent.

Palliative Treatment

There are two accepted palliative procedures, first avulsion of the peripheral branches, and second, alcoholic injection of the peripheral branches as they leave the skull. Avulsion of the peripheral branches affords only temporary relief, and such treatment is not generally indicated, since repetition is quite impossible with the return of pain. The average duration of relief from pain, following avulsion is eight months. The procedure is justified occasionally in patients suffering from supraorbital neuralgia and in patients too far advanced in years and too feeble to endure the radical operation.

Injection of the branches with alcohol is the most satisfactory palliative operation; it can easily be repeated when the pain recurs, especially injection of the superior maxillary and the mandibular branches. Injections into the supraorbital and supratrochlear nerves of the ophthalmic branch are not so satisfactory, as these points are difficult to reach, and there is danger of injecting alcohol

into the orbit and of causing severe edema and possibly ocular palsy. One, two, or three injections of alcohol are administered in cases of superior maxillary and mandibular neuralgia; this affords temporary relief and at the same time acquaints the patient with the anesthesia

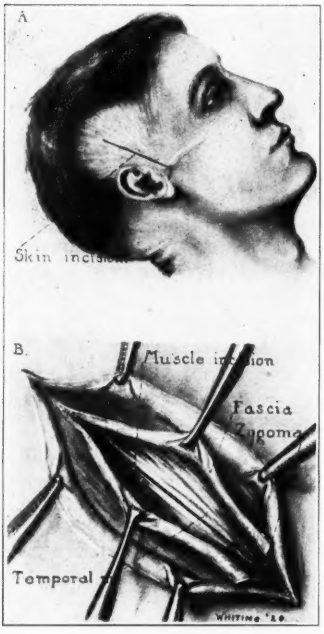

Fig. 1.—(a) Incision of the scalp beginning at the lower edge of the zygoma and extending upward in the direction of the temporal muscle fibers. (b) Incision in the temporal fascia showing the transverse incision at the lower angle.

which necessarily follows radical operation. After several neuralgic recurrences, the patient gladly accepts the annoyance of the anesthesia in lieu of the excruciating pain. If there is any doubt concerning the diagnosis, alcoholic injection is advisable; indefinite neuralgias will not yield to this treatment, while true trifacial neuralgia is definitely relieved by injections of the nerve or its immediate vicinity. Repeated injections are advisable in aged and feeble patients who have constitutional diseases which forbid the institution of radical measures.

While the radical operation is a major procedure, it is not attended with a higher surgical mortality than that associated with ordinary laparotomy, and it can be performed on patients sixty-five years of age, and older, without undue risk. Therefore, such patients should be given the benefits of radical operation and not be compelled to suffer five, ten, and even fifteen years during the declining period of their lives.

Technic of Injection

The needle used is of the trocar and cannula type, about eight cm. in length and one and five-tenths mm. in diameter; the cannula is graduated in centimeters in order to indicate the depth reached. The skin is cocainized and as soon as the proper depth has been reached by the needle, the trocar is replaced by a glass syringe, fitted into the cannula, and about two cc. of eighty per cent alcohol solution is injected. Pain is usually experienced when the nerve is approached, but this is quickly followed by numbness. The mandibular branch, injected at its exit from the foramen ovale, is reached by placing the needle through the skin at a point two and five-tenths cm. in front of the descending root of the zygoma, which almost coincides with the anterior bony border of the external auditory meatus. The needle is directed slightly upward along the base of the skull and a little backward at a depth of four cm. The superior maxillary division is injected by placing the needle through the skin, five-tenths cm. posterior to the external angle of the orbit underneath the zygoma, directing it vertically

to the anteroposterior line but slightly upward in a direction which should reach the nerve, at a depth of five cm. at its emergence from the foramen rotundum.

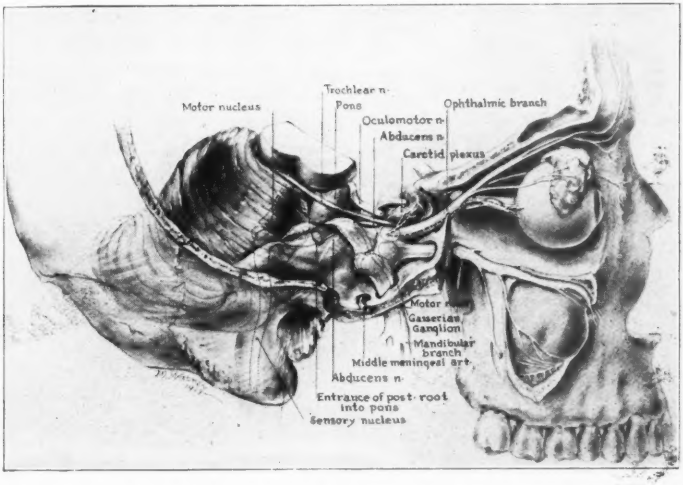

Fig. 2.—The relation of the ganglion to its surrounding structures and the communications between the carotid plexus and the ophthalmic portion of the ganglion.

Radical Surgical Procedure

In preparing the patient for the radical operation it is necessary to shave only a small area of skin over the temporal region. The incision is made in front of the ear, extending upwards and backwards from the zygoma; its lower point is one cm. in front of the tragus of the lower margin of the zygoma, and its upper point five cm. above the helix of the ear (Fig. 1). The temporal fascia is also incised for a distance of five mm. in each direction at right angles to the incision along the upper margin of the zygoma, before the muscle is cut (Fig. 2). This is followed by a trephine opening in the skull enlarged to a diameter of about three cm. It is well to enlarge the opening in a downward and inward direction so that the approach will be directly along the floor of the middle fossa. The dura is elevated, the middle meningeal is ligated, and the third branch identified. The dissection is carried upwards and backwards, elevating the dura from the arachnoid which is attached to the ganglion but is free from the posterior root fibers (Fig. 3).

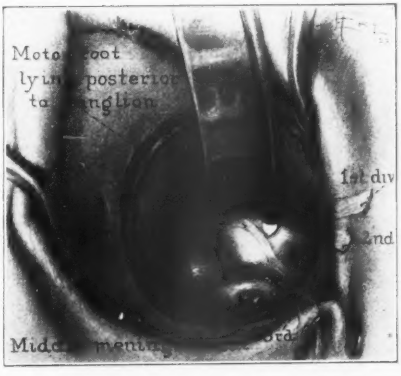

Fig. 3.—Exposure of the Gasserian ganglion with its arachnoid covering previous to division of the posterior sensory root.

As the dissection is carried up over the posterior root, the arachnoid may be seen to pulsate, owing to the cerebral pulse. The arachnoid over the posterior root fibers is then opened by a small sharp right angled knife and all the sensory root fibers in the posterior margin of the ganglion are exposed (Fig. 4). The motor root lies underneath the sensory root on the mesial side until it approaches the Gasserian ganglion; it then takes a fairly abrupt turn and passes obliquely downward and outward underneath the Gasserian ganglion through a separate sheath of the third branch into which it diffuses.

Fig. 4.—The motor root on the mesial side of the sensory root fibers of the Gasserian ganglion exposed by elevating and retracting the sensory root fibers forward, downward, and outward as they emerge from the Gasserian ganglion.

Before the sensory root fibers are divided the motor root is brought into view and preserved by gently elevating the posterior margin of the ganglion and partially rotating the sensory root outward from the mesial side. The assistant holds the illuminated retractor, and the surgeon uses one hook to elevate the ganglion and the other hook partially to retract and rotate the sensory root. The motor root is seen to lie underneath the sensory root and ganglion; it takes a downward and outward course, rather than following the posterior sensory root fibers to the ophthalmic portion of the ganglion. After the motor root has been isolated, the sensory root is divided with a sharp, small, right angled dissecting knife (Fig. 5). Care should be exercised, before closing the wound, to make sure that all of the sensory root fibers have been divided and that all bleeding has been controlled; if necessary, a small iodoform gauze pack should be inserted, and removed in from twenty-four to forty-eight hours. The muscles, fascia, and skin are closed in layers.

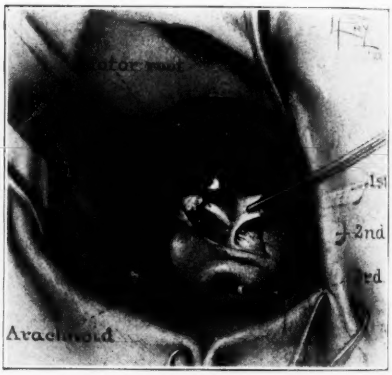

Fig. 5.—Elevation of the divided posterior sensory root fibers exposing the motor root as independent fasciculus entering a separate sheath beneath the ganglion body before submerging into the third branch of the Gasserian ganglion.

Aside from the application of ice-bags to the head for two or three days, the postoperative care is practically the same as that for general surgical cases. During operation the eyelids are closed

with a strip of adhesive which is removed after the patient has recovered from the anesthetic; the eye is then covered with a Buller's shield to avoid abrasion or unnecessary rubbing during the immediate convalescence. As a precautionary measure against the entrance of foreign bodies into the eye, or abrasions to the cornea, the patient is advised to wear a close-fitting goggle for about a year, when out in the dust, wind, or snow. He is also advised to irrigate the eye twice daily with two per cent boric acid solution in order to eliminate any possible small foreign bodies. From ten to fourteen days are required, usually, for convalescence. Aside from protection of the eye and general postoperative surgical attention, no special care is necessary.

SUMMARY

Trifacial neuralgia is a much dreaded disease; it will not stop spontaneously, but can be relieved both temporarily and permanently. Such relief does not come from the eradication of foci of infection such as removal of teeth or the draining of sinuses, but temporarily follows deep alcoholic injection and avulsion of the peripheral branches, and permanently follows the division of the sensory root of of the Gasserian ganglion. The radical operation is the operation of choice after one, two, or three alcoholic injections. While operation necessarily produces anesthesia of the side of the face operated on, it does not result in facial disfigurement or impair health, and is a godsend to the patient who is practically a permanent invalid if not relieved.

SURGICAL TREATMENT OF TIC DOULOUREUX, OR TRIFACIAL NEURALGIA

By CHARLES D. LOCKWOOD, M.D., B.A., F.A.C.S., Pasadena, California

(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

WHEN we consider the anatomy of the fifth or trifacial nerve it is not surprising that dentists have often extracted sound teeth in their efforts to relieve the intolerable pain of trifacial neuralgia. This nerve is both motor and sensory in its functions. It originates in two roots, the sensory or more important root originates in the nucleus of the pons; it passes forward over the petrous portion of the temporal bone into the middle fossa of the skull, where it expands, forming a large semilunar ganglion called the Gasserian ganglion. The motor root which is much smaller and supplies the muscles of mastication, arises in the floor of the fourth ventricle. It passes forward with the sensory root through the same foramen into the middle fossa, but it passes under the Gasserian ganglion, having no connection with it, and joins the third or mandibular branch outside the skull.

There are three main divisions of the nerve given off from the Gasserian gang-

lion. The first or ophthalmic branch which supplies the eye and its appendages and the nasal fosa; the second or superior maxillary which supplies the teeth of the upper jaw, the upper lip, the side of the nose and the mucous membrane of the roof of the mouth. Both of these branches are purely sensory. The third or inferior maxillary branch is partly motor and partly sensory and supplies the muscles of mastication, the teeth of the lower jaw, the tongue and the lower lip. The trifacial nerve has also a trophic function which accounts for the trophic disturbances in the cornea following operations upon the ganglion and also occasionally after alcoholic injections.

Nothwithstanding vast clinical experience we are still totally ignorant of the cause of tic douloureux or trifacial neuralgia. There are several forms of neuralgia which are often mistaken for true neuralgia and for which we can usually find an adequate explanation. Among these are the neuralgias of toxic origin, neuralgias arising from infected teeth and sinuses and neuralgias due to pressure by tumors or inflammatory exudates. I have records of many interesting cases of tic douloureux which on careful examination have been found to be due to brain tumors, cerebral syphilis or infections about the jaws or teeth. It is safe to say that if a satisfactory explanation is found for the neuralgia it is not true of major trifacial neuralgia. This major form of neuralgia is the type of which I am speaking and it has a number of distinctive characteristics which make it easy of recognition to one who has observed one of its victims closely.

It rarely occurs under forty years of age and it is characterized by periodic attacks of pain, referred to the distribution of the branch involved. In ninety-five per cent of cases either the superior or the inferior maxillary branches are involved. It is usually unilateral. The pain is paroxysmal and lightning-like in character; there are long intervals between attacks and there are periods of relief during attacks. The paroxysm is usually excited by some trivial thing, such as laughing, coughing, sneezing or movements of the tongue as in eating or talking. The pain usually radiates from some limited area known as a "trigger point." Touching this point will excite an explosion involving the whole distribution of the affected nerve. Sufferers from true neuralgia will shrink from the touch of a hand and will carefully avoid all movements of the face or tongue which are liable to excite an attack. They are often pitiable objects with their faces covered with undesquamated epithelioma, a mask like expression on the affected side and a look of terror in the eyes when one essays to touch them. The attacks at first infrequent and limited to a single branch tend to become more and more frequent and often involve all three branches. Such is the distressing picture of this most terrible affliction.

Treatment: The treatment of major trifacial neuralgia has come to be almost entirely surgical. Except for temporary relief afforded by morphine, medical treatment is of little avail. Massive doses of strychnin, tincture of aconite and tincture of gelsemium which were largely employed before the perfection of the surgical treatment have been entirely abandoned. The surgical treatment may be divided into minor and major.

1. Minor surgical treatment: This consists almost entirely of alcohol injections. Eighty per cent alcohol combined with one-fourth of one per cent novocain and five or ten drops of chloroform to five cubic centimeters of alcohol

solution is the most effective combination in my experience. From two to five cubic centimeters of the solution is injected at each treatment. A special bayonet pointed needle calibrated up to six centimeters and attached to a five cubic centimeter Luer syringe is used for the injection.

The injection is made into the nerve sheath or in the immediate neighborhood of the various branches at their points of exit from the skull. Injections have been made directly into the Gasserian ganglion, but this has proved dangerous and unsatisfactory. The ganglion may be reached either by the subzygomatic route, through the orbit or by introducing the needle beneath the malar prominence two and one-half centimeters external to the nostril. The most satisfactory results are obtained and the least danger incurred in injecting the superior and inferior maxillary branches at their foramina of exit from the skull.

The simplest injection is that for the inferior maxillary. The needle is introduced two and one-half centimeters in front of the tragus of the ear beneath the zygoma. It reaches the nerve at a depth of four to four and one-half centimeters. The superior maxillary branch is reached by introducing the needle just back of the coronoid process beneath the zygoma. It is carried slightly upward and backward to a depth of five centimeters, when it slips into a chink just in front of the pterygoid process. The nerve makes its exit through the foramina rotundum near this point. The ophthalmic or first division may be reached through the orbit, but this injection is fraught with danger to the eye and is seldom needed as this branch is not often affected.

The alcohol should be injected slowly, noting carefully the location and character of the pain produced. If the patient says that you have reproduced the pain of his attacks, you may expect a very satisfactory result. Pain is immediately relieved and does not recur for from nine to eighteen months. The longest period of relief I have obtained is three years.

When the lingual branch is the one chiefly involved, injection of the inferior maxillary does not always give relief. In such cases certain relief is afforded by exposing the lingual nerve in the floor of mouth and injecting directly into its substance ten minims of a one per cent solution of osmic acid. The relief is much more lasting than that afforded by the alcoholic injection.

I have made over two hundred injections for tic douloureux. The vast majority of these patients have been relieved for varying periods of time. There have been no fatalities and only twice have serious complications developed; in one case there was corneal ulceration with partial blindness and once extensive sloughing of the alveolar process and mucous membrane.

Major surgical treatment: Sooner or later alcoholic injections fail and we must then resort to major surgery. This consists of division of the sensory root of the Gasserian ganglion in the middle fossa of the skull. The early operations on the ganglion, where its removal was attempted, or the division of all of its roots, was attended by a high mortality, but the modern operation is much simpler and is attended by a very low mortality. The technic of this operation has been highly perfected and the dread that attached to the older operations upon the ganglion should no longer prevail.

The operation gives permanent relief and if the motor root is preserved only a sensory paralysis ensues. In about five per cent of cases trophic changes in the cornea occur and in a small proportion blindness on the affected side may

result. This complication is becoming much less common and those who suffer the tortures of this disease will readily accept this risk. The operation should be performed only by those who have especially prepared themselves in its technic. Most patients will elect to have the alcohol injections first and a majority of them can be kept comfortable over a long period of years.

Discussion

C. W. Rand, Los Angeles, California: I think it is rather unfortunate that the term trifacial neuralgia has practically replaced the term trigeminal neuralgia in describing these cases. The laity have come to feel that any operative interference is usually followed by paralysis of the face. This is occasionally but not generally true. The use of the term trifacial neuralgia possibly accentuates this idea. From the standpoint of terminology, trigeminal is more accurate.

Dr. Davis pointed out admirably the anatomy of the fifth nerve showing the relationship of its nucleus in the pons to the nuclei of the other cranial nerves. Occasionally in doing a Gasserian operation a transitory paralysis of the face will result. Some think that this is due to a hemorrhage in the region of the fifth nucleus which affects the seventh nucleus secondarily. This causes a transitory paralysis which clears up as the hemorrhage is absorbed. A simple severance of the sensory root is less often followed by this transitory paralysis than when the root is avulsed.

Dr. Adson spoke of the injection of the ganglion itself with alcohol as a dangerous procedure. I believe it is a very dangerous procedure as the alcohol may creep along the sheath of the nerve and get into the posterior fossa. Some very unhappy complications have occurred such as nausea, vomiting, dizziness, aseptic meningitis, etc. The procedure is a blind one at best and probably more dangerous than the radical operation.

The preservation of the motor root is a very decided step in advance. Frazier of Philadelphia is doing it in the majority of cases. It means that the patient escapes the atrophy of the masseter, temporal and pterygoid muscle groups. It also permits the Gasserian operation on the opposite side should the need ever arise.

Physicians have been inclined recently to inject the fifth nerve with alcohol intraorally. I believe that novocain can be thus employed with relative safety in nerve blocking as is done in your profession. Alcohol, however, is a tissue fixative and on injection through the mouth is apt to carry in infection and if the tissues are killed abscess formation not infrequently follows.

I also have the feeling, perhaps unjustified, that various forms of neuralgia may follow the blocking of nerves by novocain in dentistry. It is hard for me to believe that a nerve may be repeatedly traumatized without the likelihood of resulting pathology.

Truman W. Brophy, Chicago, Illinois: The first paper, presented by Dr. Davis, placed before us the structures with which we have to deal and pointed out, from a dental point of view, the position of the impacted molar tooth and the influence it exerts in being a source of discomfort to the human family. He also pointed out to us what results sometimes follow the removal of these teeth and how even more serious conditions sometimes confront the patient by their removal than if they had been left alone. He demonstrated very beautifully the effect of leverage.

I feel somewhat uncertain, in speaking about the kind of pain which occurs in impactions or other similar local manifestations termed "neuralgia." If I understand Dr. Adson correctly, the term "neuralgia" should be used particularly in cases where the pain comes from an infection. Am I right?

Dr. Adson. Yes.

Dr. Brophy. Then, if I am right, I would like to say that I am of the opinion, based upon an experience over quite a number of years, that neuralgia—we cannot go behind the neuron, behind the pons. The word "neuralgia" does not imply that the pain must come from any special source; it means that anything that produces pain in a nerve is neuralgia. It comes from the two words, "neuron," nerve, and "algeus," pain. I agree with everything that Dr. Davis has told us in his paper in speaking on the structures and on the influences of these parts, especially in impacted teeth, and I also agree with what the others have said about the pain. But I do believe sometimes that we have pain from trauma, from the dental nerve beneath, from excementosis; we have pain through the pulp nodules—sometimes extreme pain extending over a number of years because the proper diagnosis has not been made—and then there is pain from fractures of the alveolar process, because of

pressure upon the nerve by spiculae of bone, causing the pain to persist until the offending part is removed.

The question of diagnosis is all-important. If we can succeed in determining the cause of the pain, then we are not operating in the dark. We know what to do. If not due to local disturbances such as I have mentioned, as trauma, pressure, etc., then we can assume the pain must be due to some infection.

A report of one of my clinics in 1903, came to the attention of the late Dr. Edmund Andrews, a noted surgeon of that time, who wrote: "I have read with a great deal of interest the published report of your clinic on facial neuralgia—trigeminal or trifacial, as you please—and I have noted the operation you do. I have thought over the experiences which I have had through a period of years—" (At that time Dr. Andrews was an aged man. He had removed the Gasserian ganglion for the treatment of persistent neuralgia. Dr. Rose, an English surgeon, also operated for trifacial neuralgia by removing the Gasserian ganglion. Dr. Rose operated at about ten o'clock in the morning and Dr. Edmund Andrews operated in the afternoon of the same day. The friends of each presumed that he had been the first to perform that operation. When they came to compare notes they found Dr. Rose had preceded Dr. Andrews by four or five hours. Nevertheless, they both removed the ganglion on the same day). Dr. Andrews wrote this to me—he said: "How do the teeth get nerve supply after removing the dental branch of the third division of the fifth nerve?" He said: "Do they get nerve supply through the medium of the sympathetic system?" "What do you say about that?" Sometimes you may remove the mandibular nerve throughout the entire length of the canal and the teeth remain sensitive; so it shows that the nerve supply of the pericementum will cause enough energy to flow into the dental pulp to impart to it sensation.

On another occasion I read a paper in Philadelphia on the peripheral operation, Dr. Charles Fraser, Dr. DeCosta and others being present. I was asked, "Why do you operate for the removal of the terminal branches of the fifth nerve in cases of neuralgia?" My answer was, it would be folly to remove the branches if the neuralgia were due to dental infection, or pulp nodules as I pointed out, for that would not be removing the cause of the disturbance. Of course, in those days we could not well discern some of these causes, but now with the assistance of the Roentgen ray, we are able to see them.

A young woman about nineteen years of age who had persistent neuralgia for a period of two years before she sought medical or surgical relief, called on me for advice and treatment. Surgical and medical men of high class had exhausted the means at their command in making a diagnosis and finally said, there must be something wrong with the teeth. I found the pulps of two teeth had been removed.

I would like to say to my friend who spoke about teeth a moment ago—there is something else about teeth which is not generally understood and that is that the longevity of tooth life is very great but the longevity of tooth pulps is sometimes short. A dead pulp in a tooth does not mean a dead tooth. We often treat a tooth, the pulp of which is dead. When the pericementum is living the cementum lives and is in vital relation with the bone surrounding it, and the tooth continues to live oftentimes a long and useful life. However, if a pulp nodule appears it may be easily detected.

In the case I was relating, the young woman had all her teeth, upper and lower posterior to the first bicuspid, removed. She had an x-ray picture made before anything was done; two teeth had lost their pulps, there was no infection about them. When the teeth were taken out, a great portion of the bone was removed for the reason, I suppose, that the operator thought there might be some infection at the apices of the roots. After the loss of all these teeth, the pain still continued. A mistake was made in the diagnosis.

In another case, a young woman had had a pulp nodule in the third molar which was not discovered, and she was advised to have her teeth taken out. When she came to me, I asked to see her dentist. When he came, I was able to point out the nodule in the x-ray picture and advised him to remove it. He did so, and in three years no neuralgia has recurred. If all her teeth had been removed, as advised, the pain would have terminated because the tooth having in it the pulp which was constantly irritated by the nodule would have been removed, and with it the nodule, the sole cause of the neuralgia. The teeth were not the cause. That diagnosis was not made with sufficient care. That was a case of neuralgia not through sepsis. Let us try to find the origin of the disease, remove the cause and eliminate the disease.

Dr. Lockwood gave a splendid exposition of the use of alcohol in the treatment of neuralgia. I accept what the author says regarding the length of time that pain will be controlled after the removal of the terminal branches. It has been said that it is of very short duration. If you relieve pressure, the pain will soon be relieved. Take, for instance,

the third division of the fifth nerve, by reason of the pressure of a third molar being driven into it, irritation is set up and the patient experiences extreme neuralgic pain, but if the tooth that causes the disturbance is treated and cured or, if need be, extracted, the patient gets well.

I want to say that pulp nodules, even where they are very bad, are frequently overlooked. It is not a symptom of disease, ordinarily. It cannot be seen ocularly, but it can be seen by some x-ray pictures. As you all know, there are x-ray pictures and then again there are x-ray pictures. But you want a good x-ray picture and then if there are any pulp nodules you will be able to trace to them, in all probability, the origin of the disturbance. In all these cases of tic douloureux there is a quick, lancinating pain. So let the origin be traced, let the cause be removed, if local, and the patient will soon be well.

E. W. Browning, Salt Lake City, Utah: One thing I would like to bring out, is the fact that we may ignore, as Dr. Davis so ably brought out, some of these trifacial neuralgias by our removal of impacted lower third molars.

It is no longer a difficult operation to remove an impacted third molar if you have perfect anesthesia.

The first picture that Dr. Davis threw on the screen showed the position, distally, lying on the crown, up against the root of the lower second. I really believe that too many times we remove that impacted tooth and the root is exposed clear to the apex or nearly so, with the result that in a short time the second molar is lost. Therefore the third molar is valuable. Then there is the condition of the tissue, as has been referred to, and the spicula, oftentimes causing trifacial neuralgia, and the point to be noticed is that in the future perhaps it would be best to sacrifice the lower second molar for the time being and remove the lower third molar; thereby not taking any chances of causing the patient all the excruciating pain that is often experienced.

Arthur E. Smith, Chicago, Illinois: The three papers presented by the essayists are practical and scientific. Neural anatomy as presented is of great interest to the diagnostician. There is nothing so difficult in practice than to determine the etiological in obscure cases. The very complex nervous mechanism and the complicated connections existing between the cranial nerves makes it often difficult to locate.

Tic douloureux is no doubt due to either a toxic or to an atrophic process which exists at some point in the nerve branches, Gasserian ganglion or brain. A low grade neuritis caused by infection may not involve the nerve branch but will cause an endarteritis thus blocking proper nourishment. The Gasserian ganglion may show degenerative changes or there may be an impingement upon the nerve trunk by a tumor, exostosis or cicatricial tissue. Exostosis of bone has been found to penetrate the ganglion and the third division of the fifth nerve. Trifacial neuralgia should be classified into one of the following forms: First, peripheral or preganglionic type; second, the ganglionic type; third, the retroganglionic or intracranial reflex types caused by tumors, etc.; fourth, symptomatic pains caused from other lesions which yield to a different treatment than that for the primary type of tic douloureux. The severing or resection of the sensory root is superior to Gasserectomy as it does not impair the motor nerves which supply the muscles of mastication, less hemorrhage is caused and is not so radical. I have a skull which shows a complete division of the foramen ovale and in one of Dr. Frazier's papers he places emphasis upon exostosis dividing the foramen ovale thus causing a division of the third branch. I agree with Dr. Adson that the injection of alcohol into the Gasserian ganglion is a technical procedure and in the hands of the inexperienced is dangerous. Dr. Neil of Vanderbilt University and myself in 1918 did research to evolve a new technic for blocking the Gasserian ganglion. This technic makes it possible to locate the foramen ovale and to know the exact location of the point of the needle while advancing it into the ganglion. A triangle is employed, the technic is based upon accurate measurements and geometry. In evolving the technic many cadavers were dissected and injected. Methylene blue was injected to stain the tissues and to check the area injected. My results from blocking the Gasserian with alcohol have been very satisfactory.

I agree with Dr. Brophy that alcohol properly injected is a valuable procedure and should always be done before a neurectasis or an intracranial avulsion of the sensory root of the fifth nerve or a Gasserectomy is performed. The alcoholic injection should be made even if it gives relief for a short time, as it gives the operator an opportunity to observe the condition of the patient and to study the symptoms. If alcohol does not give permanent relief then there is plenty of time to resort to one or other of the radical operations. I have observed some operators injecting alcohol without first injecting a local anesthetic and an

operator who is guilty of such a procedure has no regard for his patient or the pain he inflicts. Alcohol should never be injected without first blocking the part with a local anesthetic. The suspected nerve should be blocked first with a local anesthetic which is advantageous in determining whether or not the paroxysms of pain may be elicited. I do not add the alcohol to the local anesthetic. Two separate injections are made. It might be well to call your attention to the findings of Sluder. He has called attention to a pain syndrome and states that undoubtedly the pathology due to irritation of Meckel's ganglion manifests itself as neuralgia and is somewhat common. The findings of Sluder will no doubt throw some light on many obscure cases.

A number of dentists have stated that they made such and such an injection several months ago and that their patient still experienced a numbness of the part. There are two common reasons for such a condition. First, excessive curettage which produces a severence of the inferior dental nerve or a traumatization of the nerve fibers. Under block anesthesia the patient is oblivious to pain and the radical operator can damage the nerve by a too generous use of the curette. The second cause of postoperative numbness is from injecting a solution contaminated with alcohol. If alcohol is employed as a sterilizing medium for the syringes and needles care should be exercised in the thorough removal of all traces of alcohol before filling the syringe with the local anesthetic injecting solution. Contaminated solution from alcohol has caused many an operator trouble and anxiety and for that reason I have recommended other solutions for sterilization.

The first named cause of postoperative numbness, namely that of nerve severance or traumatism by the curette can be avoided by exercising caution in the curettage of pathologic periapical tissue and in the application of the elevators in the extraction of teeth, especially broken down teeth and impacted lower third molars. Block anesthesia and curettage are both indispensable and like all surgical procedures caution and skill must be employed when they are utilized.

Dr. Davis (Closing): Dr. Rand asked a question about injections causing premature death of the pulp, and whether or not continued novocain injections might be traced as one of the causes of neuralgia. The premature death of pulps is not caused primarily by the injection, but oftentimes may be traced to improper surgical procedures by incompetent or unskilled operators.

Properly made injections, per se, cause no symptoms of neuralgia, cause no premature death of the teeth, that I can tell you! Sometimes, through lack of care alcohol is left in the syringe, as Dr. Smith has brought out, or perhaps through improper use of the curette paralysis of the nerve occurs. I agree with Dr. Rand on most of the points of his discussion. Speaking of dead teeth, how the nerve functions sometimes are restored after the apparent loss of the sensations in the teeth, I can only recite to you a case where an antrum was operated by a nose and throat man, and in making the opening in the bicuspid region some of the nerves were severed, causing the apparent loss of nerve supply to about four teeth on that side. But they cleared up in about three to six months and all sensations were restored. I am of the opinion we may get restoration of function through the vegetative system.

Dr. Rand asked about the pressure from the impacted teeth which lie just above or within the mandibular canal. I can only say that continued irritation may cause some degeneration in the nerve or its branches and continued pressure may go on until we have a pressure necrosis or some more severe symptoms of neuritis.

Dr. Browning said that inasmuch as we were having so much trouble with the removal of the third molar and because so often the roots of the second molars were involved, that he might go home with the feeling that it would be better to take out the second molar. Now I did not want to leave that impression with you. That is the very thing we are trying to avoid. That second molar belongs to the patient and if it is possible for us to save any part of the masticatory apparatus it is our duty to do it. I am sure that with the proper removal of the third molar the second molar can be saved in the majority of instances. I agree with Dr. Smith relative to what he said about alcoholic injections and in my paper I spoke about alcohol injections being disappointing, as a cure. As a palliative measure there is nothing better.

Dr. Adson (Closing): Complications such as hemorrhages, paralysis, and keratitis were at one time so prevalent and so serious that the radical operation was not considered. With the exception of an occasional facial paralysis which is only temporary and which recovers without complications, if the cornea is properly covered with a Buller's shield, these complications have all been eliminated. Another postoperative complication to be carefully guarded against is keratitis which may develop if the cornea is abraded. To avoid this, it is neces-

sary to close the lid during operation with adhesive and to protect the eye with a Buller's shield for five or six days following operation. Automobile goggles should be worn when the eyes are exposed to the wind and dust, for a period of at least twelve months after the operation. It is also well to irrigate the eye with a two per cent solution of boric acid twice a day to insure removal of foreign bodies that may have entered the eye without the patient's notice.

Dr. Brophy directs attention to a traumatic neuritis which follows surgery of the teeth and mandible. This may be likened to the neuritis that follows crushing injuries of the extremities and must be distinguished from trifacial neuralgia because traumatic neuritis is rarely relieved by alcoholic injections or by radical operation. Alcoholic injections are not always successful, because the alcohol may not be injected into the nerve or its immediate vicinity, also because of the cicatricial tissue which is the result of numerous alcoholic injections into the nerve. True trifacial neuralgia is due to changes in the Gasserian ganglion and, in all probability, develops subsequent to an infection of the ganglion. The removal of foci of infection does not change the course of the disease and in order to cure trifacial neuralgia, it is necessary to divide the posterior sensory root.

Dr. Lockwood (Closing): I cannot conceive from my experience how infection could be a very direct cause of this disease. There are just two factors that it seems to me have a bearing on these cases. First, the majority of them are very, very old people and a great percentage of them have high blood pressure; second, we know that the nerves involved pass through and along narrow bony canals. We know that blood vessels accompany these nerves through their sheaths. In cases of high blood pressure I can see how we might have pressure and pain. As far as I have observed most of these people have all their teeth out, their tonsils are atrophic, they have no fever, and unless it is due to changes such as occur, in arthritic spine, I cannot see how infection could play any important role.

Now, the second point I want to touch upon is the point concerning repeated injections. This has to do with the number of injections, as suggested by Dr. Adson. In my opinion not less than three should determine the time of operation. To be more correct, I should perhaps say after three unsuccessful injections it might be advisable to perform the radical operation. But I think it should be determined by the efficiency or ease with which you can relieve the pain. I have been able to relieve patients over a long period of years by a single injection. I have patients who come out here every year, they are injected and relieved during the intervening time, until they come out again. I know in my own case I would not consent to having the major operation performed until after the third injection, that is, until after I had had three unsuccessful injections.

FEEDING THE CHILD FROM THE STANDPOINT OF A DENTIST

By M. EVANGELINE JORDON, D.D.S., Los Angeles, California

(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

WE BOAST of our civilization but we starve our children. Too often we start them on some widely advertised milk or malted milk, feed them on prepared breakfast foods and continue on hot, soft, rich foods. It behooves us to urge more breast-feeding of infants and with older children to go back to the sensible supper of our grandparents of whole wheat or corn bread and milk.

The laity is aware that there is some connection between diet and the overwhelming prevalence of caries of the teeth in childhood and is questioning the profession in its endeavor to save children unnecessary suffering.

Every child has a right to perfect health through a healthy mouth. This is a normal condition. Unfortunately, nearly every child has very imperfect teeth. To overcome this unnecessary suffering of the child is a problem that must be faced squarely by the dental profession. Until recently little care was given to the health of the child from before the time it walked until it reached the kindergarten age.

When in the war, one-third of our boys were rejected, an investigation showed that all but ten per cent of those cases whose health was below standard could have been prevented by proper care during childhood. The dreadful effects of such neglect started a national movement of conservation of the health of the pre-school child, often called the run-about. The old habit of putting the child at the table in his high-chair, and forgetting or not knowing that children should not eat the same food as their parents, and letting him select his own diet, was followed by so much indigestion and illness that the resistance to disease was greatly lowered and children fell victims to epidemics of measles, scarlet fever, whooping-cough and diphtheria in large numbers. If they survived, they frequently succumbed in later years to tuberculosis due to the weakening of their systems from such diseases as whooping-cough and diphtheria.

The survey made during the war of the youth of our country, pointed to the urgent need of conserving the health of the children with the result that health bureaus, staffed by efficient corps of workers, have been established in most of the states. At the present time their work is being directed toward the forming of *proper habits* in the pre-school age. These signs of the times clearly point to the fact that the dentists of the country must organize, for the care of the teeth of the pre-school child or lose their professional standing.

The following is taken from the editorials of a child's magazine:

"At an orphanage in Boston (1), measles, scarlet fever, mumps and other diseases of children annually afflicted about one-third of the three hundred and twenty-five inmates. Then the authorities instituted a regular dental service.

After eight months of dental work the diseases almost disappeared; from which it is a just assumption that healthy teeth greatly increase the children's power of resistance."

Is the profession prepared to meet the public demand; not with talk or temporary work but with careful constructive work? Is the dental profession lagging behind in its service to the public? Dr. Hartzell's slogan was, "Let's Add Ten Years To Life." Is the profession prepared to do in early childhood the work which will add these years?

Dr. Gorgas made it possible for the United States to dig the Panama Canal by teaching how to protect life from yellow fever and malaria. Why was there not a dentist upon this staff to *teach* the children of the diggers how to preserve their teeth? The children coming out of the canal zone now, show the painful results of such a lack of knowledge. Their unbalanced diet has caused the premature loss of the deciduous teeth before their time resulting in contracted jaws and the permanent teeth carious and broken.

Imperfect teeth of the child are due to two causes, first heredity and second environment. Heredity plays a very small part such as the transmission of the fifth cusp in molars or more rarely the nondevelopment of certain teeth.

Environment plays by far the largest part in the history of dental caries. We have as example the history of the American Indian as shown by the skulls of both the adult and the child, compared to his present day descendants. We also have the Mexican, the descendant of the Indian and the Caucasian, in his native environment, compared to him as a city dweller.

The early Indian had a diet of meat, some grains and vegetables but only a little sugar, mostly derived from dried fruits and honey. The peon or cholo in his native village also has a simple diet of hard bread, from the whole grain, vegetables and a little brown sugar.

In both cases we find nearly perfect teeth but when either the Indian or the peon comes to the city to dwell, he falls before the temptations of the candy shop and the alluring white bread and cakes of the bakery, with the result that his teeth lose their resistance to caries. In examining the mouths of the Mexican children in a kindergarten it was found that those who have lived in a city all their lives have badly decayed teeth, while those who have lived in a primitive way most of their lives, generally have perfect teeth.

Perhaps the greatest mistakes to be classed under environment are soft foods, sugar and white bread. Why children are kept upon soft foods, after they have teeth is always a mystery to me. A child is an animal. Is it not a mistake to feed a child, with teeth, on mush when other young animals are given hard foods at an early age? In studying the effect of diet upon animals I have seen several young pedigreed cats suffering from an advanced stage of pyorrhea, due to being fed upon chopped and mashed foods and have never seen anything but healthy mouths in common house cats, unless they were very old.

The selective diet of the average child does not include hard foods and vegetables. For this reason the wise mother begins in babyhood to train the infant's appetite by including in its first food, the puree of vegetables, eaten with sticks of dry toast or zweibach. If the small child is allowed to drink cocoa or chocolate he will refuse vegetables, and also will very soon stop masticating his food which will result in poor development of the jaws, and also in a deposit upon the teeth that will very quickly permit the growth of caries in all grooves and fissures and upon the buccal surfaces of the molars. Such cases usually show a coated tongue, and teeth are not *safe* when the tongue is coated.

In my practice I have found nothing that leaves the teeth more coated and the periodontal membranes softer and

more hyperemic than cocoa and chocolate drinking. Children with such habits are often more or less anemic. *The chief danger* is because the hot, stimulating, rich, sweetened drink, easily satisfies the appetite and not enough rough, hard and wholesome food is eaten to nourish the body.

From a dental standpoint, the expression, "protective foods" is not synonymous with, "foods containing vitamins" but the lines closely parallel as we must consider both good nutrition and exercise of the teeth and jaws.

In child life, good nutrition, should produce steady growth, full weight, control of nerves, good disposition, abundant energy, mental power and resistance to disease.

For the pre-school child, we are almost limited to bread, for the development of the teeth and jaws. For that reason, all of the child's bread should be given in the form of toast, zweibach or crusts and because in the milling of most refined white flour, two-thirds of the lime salts, and nine-tenths of the iron and phosporous are removed, those very necessary mineral salts for a developing body, whole wheat bread should be used instead of white bread.

Some of the men who have done notable work on foods, have not dwelt upon the dental aspect of the conditions confronting us. Is this not the fault of the dental profession? Have not most of us been blind to any connection between food and teeth? As a large part of the diet of the child is derived from grains, if he is to get enough lime etc., to build perfect dentures and to keep them perfect, he must eat the whole grain with its average of three times as much calcium and its iron and phosphorous much of which are lost, together with the vitamins, in the removal of the germ in the milling of white flour.

The child who lives on chocolate and soft white bread, not only does not get enough lime salts to build strong bones and teeth but is lacking in the necessary lime for every function of the body; the beating of the heart, the development of the brain, the digestion of the food, and the formation of healthy saliva, in fact the child is being slowly starved, with resulting malnutrition.

Malnutrition plays an active part in the malformation of the teeth and may be due to prenatal or postnatal disease. This malformation is called hypoplasia.

Deciduous teeth showing hypoplasia are not common, but when encountered present a problem difficult to solve. The broken and pitted surfaces in the enamel make the teeth very sensitive, and these sensitive pits must be filled when the child is so young that the small mouth and the fears of the child present a serious problem.

Malnutrition during the first year, due to a severe illness or from a difficulty in the selection of an artificial diet, frequently causes faulty development in the first permanent molars. These are perhaps the most often found of all hypoplastic teeth. If the illness continues into the second year we may get badly formed edges of the incisors etc., the lines of imperfectly developed enamel, plainly pointing to the period of malnutrition in the life of the child.

Milk is the most valuable of our protective foods, and in early childhood, when uncooked vegetables cannot be used, it is the chief source of vitamins. When heated in making chocolate or cocoa, some of these necessary agents of health are destroyed, cutting down one protection against disease.

The vitamin fat-soluble A (2), the one stored in the body, appears to be an important factor in its general stamina and ability both to resist disease and to meet the demands of reproduction and lactation.

Since vitamin A is so important both in health and disease, and since any surplus received in the food can be stored in the body for future use, it appears wise that foods known to be rich in vitamin A notably milk in its various forms and

the green vegetables, should be used in the diet as liberally as practicable.

Where children seem unable to digest milk, I have repeatedly found that by temporarily depriving them of refined sugar they could digest milk and willingly accepted a large amount in their diet.

In refined sugar some of the valuable elements are lost and children thrive much better, from a dental standpoint where they derive their sugar from raisins, figs, dates, prunes and other fruits and also from honey.

McCarrison (3) in speaking of the freedom of uncivilized races from gastro-intestinal disturbances, among other things, says, of a tribe in the Himalaya Mountains, "Not as much sugar is imported into their country in a year as is used in a moderately sized hotel in a single day."

The following is taken from a government bulletin, printed from data upon the effects of influenza:

In a girl's school (4) in a southern state where the diet included much milk, dark breads, fruits and vegetables no one of the two hundred students was ill more than two weeks during the epidemic of influenza, there was no serious illness and not one case of pneumonia followed. The most remarkable part of this report was that not one of them showed any breaking down of the teeth. In other schools of the same general type where the food did not include milk and dark breads the picture was very much the reverse.

As the child during the period of development, needs ten times the amount of lime salts that he will need in adult life, the certainty of its source must be assured.

If he were to drink a quart of milk daily and eat sufficient raw vegetables, the source of lime salts and vitamins would be assured, but the large majority of children will not do this, hence the need of whole wheat bread.

Beside this, the pre-school child is not, by most dietitians allowed raw vegetables but is limited to cooked ones so there is some loss of both vitamins and lime salts, the former through cooking (cabbage was reduced from first place raw, to third when cooked, in the first report of the Medical Research Committee of London) and the valuable mineral salts are often wasted by throwing away the water in which the vegetable was cooked.

In examining hundreds of pre-school children both in clinics and in my office I find the greatest offense against the laws of dietetics is the feeding of too much sugar.

Caries appear very early in the life of the child and the second deciduous molars suffer the most as the child has begun to run about before their eruption and the vigilance surrounding his diet has relaxed.

The sugar packs around the teeth and in the fissures of the partially erupted molars, and the enamel often has disintegrated before the molars are all in occlusion. Unless these teeth are cared for they are often lost before the fifth year and with their loss there is a loss of space in the development of the jaws. In the eleventh or twelfth year there is not enough space for the erupting bicuspid which makes its appearance lingually or buccally and is often rotated.

Vegetables are very necessary for the pre-school child but at first must be given as a puree with hard toast. Other cooked vegetables and tender lettuce, also raw apples may carefully be introduced into the diet as soon as the deciduous teeth are in good occlusion.

Fruit juices (without sugar) should be a part of the infant's diet and if oranges are lacking, tomato juice is a good substitute. Canned tomatoes are one of the exceptions to the rule that cooking destroys vitamins.

The careless habits of children in irregularity of meals is another source of caries. In surveys made in different states it was found that many children

went to school with no breakfast. We must join with the health workers and tell the mothers that this must not be. Then it has been found that unless watched, children do not eat the good lunches provided by many schools or by their parents but slip away to the candy shop or drug stores on the corner and lunch on coco cola and ice cream sodas. I have known cases where children sold their carefully prepared lunches to wiser children and used the money to buy doughnuts and soda water.

Of course such children are hungry at four o'clock but what is the usual lunch? Cookies, cake, jelly and jam. When dinner arrives, the appetites are satisfied with so much sugar and they refuse the wholesome vegetables, meats and fruits. Is it any wonder that so many children are undernourished? The only wonder is that so many live.

The child should go to school fortified with a breakfast of fruit, unsweetened thoroughly cooked oatmeal eaten with hard toast, egg and milk; and should have a lunch, simple but wholesome. A small bottle of milk is indispensable. To this should be added a sandwich of dark bread and the crusts left on, spread with ample butter and filled with lettuce and chopped nuts, olives, carrots or cheese or any filling that the child will relish. Also a sandwich may be made with raisins or dates or they may be eaten free. Children enjoy gingerbread or hard cookies made of oatmeal with chopped nuts or raisins but pies and rich cakes with frosting should be excluded. The lunch should end with an apple, which leaves the teeth clean. If the appetite for dinner is not to be spoiled, the after school lunch should consist of a little fruit or a raw carrot.

It is being found by health workers that the vast majority of dentists are shirking their duty and extracting the teeth of children instead of filling them because of their lack of patience or knowledge in handling children. In some cases it is because the dentist fears to lose the family from his practice not realizing that later when the expense of restoration is to be met he will be bitterly blamed for his unwise conduct. If the dentist assumes this unprofessional attitude the *careless* parent goes a step further because it is cheaper to extract even permanent teeth than to repair them.

The duty of pedodontists and oral hygienists is to make each individual dentist feel the responsibility he owes humanity.

"Our lives are a mass of habits. Education is the forming of habits. The one great business of parents and teachers is to see that our habits are what they should be" (5). Originally, parents were the teachers, then it was found that one person trained to teach was more efficient and would release thirty or forty parents for the other duties of life.

Teaching has become specialized, until now the overwhelming avalanche of dental caries with the long sequelae of disease has forced dentists into the role of educators. Oral hygienists are being educated to meet this need but they are too few. Every dentist must lend a hand.

In addressing an audience of oral hygiene workers and pedodontists, I appeal to you to grasp every possible opportunity to bring before the dentist in general practice the duty he owes his patient both in caring for the teeth of children and helping them to adopt a diet that will add ten years to life.

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Discussion

Guy A. Woods, Portland, Oregon: Dr. Jordon has proven in her chosen lifework that dental work for children and proper control of their diet can so nearly overcome the tendency to caries, that children can be given useful comfortable deciduous teeth and then carried on to maturity with practically flawless dentitions which will mean efficient mastication for the lifetime of the patients who receive this care.

I am glad Dr. Jordon began her paper with an appeal for breast feeding of infants. This is a vital time in a child's skeletal development. Greater development of the skeleton and teeth occurs in the body during the first year than during any other similar period, and this is the period when nature intended that the mother should supply the child's food. No artificial formula can be expected to uniformly produce as substantial teeth as mother's milk. Then too we must not forget that there is the mechanical advantage to be gained from nursing, in the broadening of the vault and jaws, the enlarging of the air passages, and strengthening of the muscles of mastication. All babies nourished as nature intended they should be by mothers who themselves are properly nourished, should be our ideal.

The proven importance of vitamins for growth makes it imperative that the food of childhood should be especially rich in these factors. I agree heartily in all that has been said relative to a child's diet being rich in milk, raw and cooked vegetables, whole wheat bread, and fresh fruit with hard food added to encourage vigorous mastication. We can not do better than to confine our efforts to advising such a diet and to discouraging the use of sugar, candy, gum, and mushy, sticky foods and desserts.

Extensive animal experiments which are being made by such men as McCollum, Howe, Grieves and others, when collaborated by clinical results in the mouths of children over long periods of time, point clearly to diet as a factor of the very greatest importance in determining the quality of the teeth and their ability to resist decay.

I disagree most emphatically with the pediatrician whose paper was read at this convention, when he says that "Dentists have no right to interfere in the selection of a child's diet." We have allowed the medical profession to rule in the realm of diet until today 90 per cent of the school children of America have deficient, decayed or malposed teeth. Since they have not succeeded in properly feeding children to produce good teeth, and since men in our profession are succeeding by scientific experiments in proving what a properly balanced diet will do in this regard, I maintain that we as members of the dental profession are recreant of our duty if we do not give our patients and the community at large the benefit of our knowledge of dietetics.

W. H. Card, Minneapolis, Minnesota: There are two or three things that I want to emphasize; and one is that, in the normal child, the tendency is to too much milk. We know milk is a splendid food, but we sometimes carry milk feeding too far. In other words, the development of the child's jaws, the development and eruption of the teeth to a great extent are influenced by the addition of other foods, and as the teeth are erupting so should the foods that need to be masticated be added, and as they are added so should the milk diet be lessened.

Psychology has to be employed in teaching the child the adoption of new foods. If you force milk in too great quantity upon this child, you are going to have greater difficulty to get that child to take to the foods that he needs for mastication. Mastication develops the jaws and also is a factor in brain development. Experiments made in the last year or two have brought that out quite forcibly. We should see to it that the normal child, as fast as is in keeping with the development or eruption of those teeth should have those hard foods that need mastication added to his diet. Mastication is also a factor in oral hygiene, as you know, and I am very strongly in favor of fresh fruits as a dessert not only because of the value of those fruits as foods but also because of the hygienic value in cleaning up the mouth and leaving it in the condition that it should be. I do not mean by this that children need not brush their teeth, but that if they eat fruit they will be gradually getting into that ideal diet habit and as a result the need of the toothbrush would not be so great. We also know that sweets are bad. Children that eat sweet foods not only destroy their appetite for the proper foods, but they also have that vicious attachment and lodgment on the teeth than makes them so liable to decay.

Fatty food is another food that we must be a little careful about for the children, because it also destroys appetite for the foods that they need more. During the war, there was an investigation in New York brought about by the bakers increasing the price of white bread per loaf; and in that investigation was brought out the fact that not only were the vitamins, the best part of the wheat, removed, as we know happens in highly milled white flour, but they also used gypsum, or plaster of paris, to slow up the

leavening process so they would get a finer texture to their bread.

Another thing, speaking of the destruction of the vitamin contents of food in cooking and canning, it is only in the last few years that nutritionists have come to the use of tomato juice for infants where infants would not perhaps take orange juice, which is a very valuable adjunct to the child's diet. They use the canned tomatoes, because in the process of canning the vitamin content of the tomato is not lost.

There is one thing we must not forget, and that is the time to begin to develop the teeth and jaws of a child is before it is born. That means that at every opportunity we have we should pay the greatest attention to the food of the mother. Now, dentists as a rule are not made aware of the coming child until possibly well along toward birth, sometimes not at all; but it should be different. The dentist should know, and he should have just as much to do toward the molding of that child as anybody else, especially if the mother is of that type or that class that does not perhaps have proper medical guidance. Now, in this day in our large cities among the people of comfortable circumstances, most mothers are in excellent hands as far as medical attention is concerned; but there are many cases where it is not true. We know that diet is the greatest factor in caries; and it does not seem to be consistent with our professional degree, that we should not be allowed to prescribe diet.

Haidee Weeks Guthrie, New Orleans, Louisiana: I think that our first duty as dentists is to try to co-operate with the pediatrician and the obstetrician. I do not agree that the oral hygienist should be the one with whom we should leave this important, the prenatal, care of the child, because I think we dentists come before the hygienist, and before the hygienist I think we should have both the pediatrician and the obstetrician.

Why do the children buy candy for their luncheon? Why do they give up their food? There is some reason for it. There is something lacking. There is something that their appetites crave just as naturally as animals want the salt lick.

Paul A. Barker, Denver, Colorado: I would like to ask Dr. Jordon to what limit, to what extent is the dentist or general practitioner warranted in prescribing diet in case we find the pediatrician or general practitioner is not giving a proper diet according to our viewpoint? Are we warranted in removing the case from their hands, if possible, or advising the removal and change to another pediatrician or another practitioner? Or should we attempt to co-operate and suggest with the practitioner as to the proper diet?

Dr. Jordon (Closing): In speaking of milk I quite agree with the discusser. Milk can be given to children in other forms; but as they grow older some other foods must in part take its place. Cream soups with vegetables is a very good way in which to persuade children to take milk. I think one of the mistakes in the past has been that vegetables and plainer foods have been so unattractive and so tasteless that the average child would not eat them. If attractively served children can be persuaded to eat almost any food.

Now, with regard to the question Dr. Barker asked me. It is a very delicate subject. To give a specific case: a child who was perfectly normal and healthy at one year of age, was referred to me by a dentist when it was two years old. Her teeth had no enamel upon the labial surfaces. She had sucked her thumb through nervous irritation until she may have to be treated by an orthodontist. This child had been taken off the milk diet at one year. She had been given malted milk and some sort of mush paste, a glass of orange juice several times a day, and also barley sugar candy. She had had no hard foods. On this diet she had reached a point where she could not sleep nights. She suffered very much with her teeth. I feel that a pediatrician who orders such a diet is not a safe guide for children. It is a question that has seldom arisen with me, in my home town, because I work for practically all the families of pediatricians here, from their infancy until they are old enough to go to their family dentist. There has never been an argument except once when a pediatrician called me up in great anxiety because I had told the mother the child must change his food. The child came to me with the enamel so soft one could scrape it off anywhere. I said, "My dear doctor, I don't want particularly to change what you are giving. I *certainly* want you to change the *form*. For the future please give some of your foods in a hard form."

FURTHER STUDIES IN TRIGEMINAL NEURALGIA

By S. L. SILVERMAN, D.D.S., F.A.C.D., Atlanta, Georgia

(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

AT THE Boston session of the American Medical Association in June, 1921, I definitely called attention to what I considered two paramount points in connection with the subject of trigeminal neuralgia. That my readers may follow the present contribution, I here quote verbatim the points above referred to as they appeared in the *Journal of the American Medical Association* (1).

"The purpose of this paper is to establish two paramount points: 1. I have discovered that the buccal branch of the inferior maxillary division, though affected very often, is hardly ever diagnosed, and different from the supraorbital, infraorbital and mandibular branches; the 'trigger zone' is vague and may sometimes give the impression that the neighboring nerves are the affected ones. 2. Deep alcohol injections are more difficult and less certain, even in the hands of experts, than are well placed peripheral injections. To this should be added that alarming sequelae have followed this procedure. Patrick, Cushing and others have reported quite a few complications of a grave order following deep alcoholization.

"Aside from Blair's[1] mentioning the buccal injection, I have never encountered, in the voluminous literature on the subject of trigeminal neuralgia, the buccal as a branch capable of becoming affected."

It is now over a year since this appeared in print, and the additional experience in handling quite a number of trigeminal cases leads me to reaffirm the views then expressed.

The literature on the subject reveals the fact that little or no improvement has been made in the treatment of this dreadfully painful malady during the fiscal year just passed. To the contrary, the mistakes of old as regards etiology are again and again paraded, and what is worse, ineffectual treatments are advocated in spite of the fact there are two and only two ways that should ever be employed. In a recent issue of the Munch. Med. Woch. (2) von Payr in a rather lengthy presentation remarks as follows: "A choice of treatment must be made in the early stages of trigeminal neuralgia so as not to lose valuable time in fruitless efforts" and then negates this sterling advice by advocating eradication of dental ills and in turn recommends medical measures from aspirin to veronal. Should the drugs fail, the aperients either at home or at the watering places are to be tried. Operations for abdominal disorders, if found; also, salversan and other antisyphilitic measures. "Electric treatment (galvanic current) is often beneficial," remarks von Payr, "but should be discontinued after two or three weeks if no results have been obtained."

[1]Since the publication of the above I find mention of the buccal nerve by C. M. Byrnes, Tice's Practice of Medicine.

He also recommends suggestion and hypnosis. Lastly, all these measures failing, deep injections of alcohol are recommended followed by intracranial operations where necessary. He concludes his article with a history of several of his cases for which he performed intracranial operations with good results.

This article is one of many that serves to show how cases of trigeminal neuralgia are made to suffer physically and financially. Many are the measures, and varied are the remedies suggested for this malady. I have in a previous paper (1) referred to Sir Arbuthnot Lane's intimation that the removal of the colon has cured trigeminal neuralgia, and I know of cases where this has actually been tried.

In my previous paper, I made the statement that all branches should be injected with the single exception of the mandibular. I now, however, state that even this branch can be injected and have, therefore, not performed a single neurectomy in the past year.

It appears dogmatic and definitive to many when the statement is made that the etiology and pathology of trigeminal neuralgia are unknown. But it is nevertheless true. Dentists in particular are wont to question the statement and have so expressed themselves to me. Experienced investigators, however, know that no dental disorder of whatever nature has ever caused a trigeminal paroxysm. They also know that the removal of any dental disorder or anomaly has never, in the least, been productive of results. Some years ago, I believed that impacted teeth, pulp stones and exostosed roots were capable of producing this disease, but I was in error. Please bear in mind that I do not deny that the above mentioned disorders do not produce a neuralgia; but the neuralgia thus produced is of a minor order as compared with this most excruciating form that the laity know as tic douloureux.

At this point, I would like to call the attention of dental surgeons to sphenopalatine neuralgia not because it at all resembles trigeminal neuralgia, but because the injection of Meckels ganglion with alcohol will at times be successful in stopping the pain. Greenfield Sluder (3) has described a vague character of neuralgia that is oftentimes referred to as Sluder's neuralgia, and is of a type often seen but rarely diagnosed by dentists. His description in substance comprises; a non-excruciating pain in the upper teeth and jaw, sometimes in the lower jaw; about the eye and at the root of the nose, at the temporomandibular joint and in the ear. It radiates to the mastoid region thence to the occiput and neck and downward to the shoulder and even to the arm and hand. At times the patient will complain of an "aching" throat, but no inflammation is to be discerned. How many times has this complex syndrome of complaints been made by patients visiting a dentist and been immediately dismissed as a fussy case of neurasthenia? Whether or not alcohol injections in Meckels ganglion will relieve this disorder is still a question, but our thanks are due Dr. Sluder for recognizing its existence.

Cadwalader (4) recently reported quite a number of cases of tumors of the Gasserian ganglion and so has Cushing. Although they had found the ganglion flattened by pressure, the cases not only were not neuralgic of the major type but, on the contrary, oftentimes resulted in anesthesia of the affected side. In a word, whenever trigeminal neuralgia is found to be associated with dental disorders or intracranial tumors they are merely coincidental and their removal is without effect on the disease.

Peripheral vs. Deep Alcoholic Injections

It is my purpose to prove that peripheral injections, with the proper needles in the hands of one capable of visualizing

beyond the cutaneous surface, are more effective and more successful than deep alcoholization, even by those whose experience would entitle them to be classed as experts. To cite from one who has probably performed more deep alcoholizations than any in this country is sufficient to carry my point.

Patrick (5) states that he has made about 500 deep injections, and has missed the nerves entirely in about 26 per cent, was "partially successful in 43 per cent," and successful in only 31 per cent, or less than one-third of the entire series. Similar data is furnished by other advocates of the deep injections. On the other hand, I can report that in several hundred injections, I have yet to fail injecting a given branch. It is true that there are some forms of trigeminal neuralgia that do not run true to type symptomatically, and in such cases not only will peripheral injections be short-lived, but even well-performed Gasserian operations will be of no avail. Cushing has had these experiences (6) and cites a case of particular interest. He relates that his case No. 93 entered the hospital with a history of twelve years of neuralgia and marked motor spasms. Because the pain started in the eye, a surgeon removed it. Following this he had his supraorbital nerve removed. Two attempts to remove the Gasserian ganglion were unsuccessful. Dr. Cushing successfully removed the ganglion but the pain continued unabated. The geniculate ganglion was then destroyed and a spino-facial anastomosis made. For six months the patient had a moderate relief, but the pain returned in an insufferable manner. The patient was "desperate and suicidal" and further operations in and about the ear were performed by his home surgeon. Following the last one of these "death brought the only relief that he had had in sixteen years." I have had to inject a number of cases where the Gasserian has been previously removed, and have been fortunate in ameliorating their intense suffering. However, in the true type with atypical symptoms proper peripheral injections and intracranial operations are to say the least 95 per cent successful.

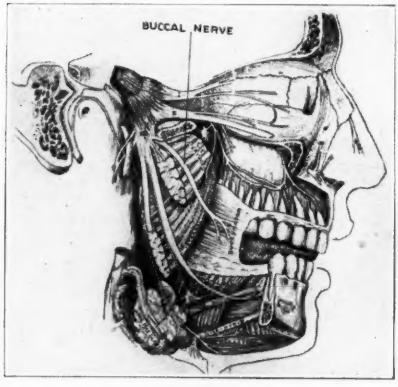

Fig. 1.—The buccal is here admirably shown. Note that the region in which it lies makes it susceptible to stimulation from either the mandibular or infraorbital regions.

Sometime ago I brought forward the theory that the buccal nerve was more often affected with tic douloureux than is generally supposed. When affected it may be mistaken for the infraorbital or mandibular branches. This, because it occupies the area between these two branches (Fig. 1). Also because the buccinator muscle (which is supplied by the buccal) decussates at the corner of the mouth and this intersection of fibers I believe is sufficient for the deception to assert itself. Oftentimes the operator is misled in imputing to another branch what rightfully should be assigned to the buccal. This phenomenon I have termed a "mirrored trigger zone" and differs from Patrick's "dolor genetic" zone inasmuch as it (the buccal) and

not the neighboring branches are dolor genetic, that is, when touched with finger, towel, brush or other epicritic stimuli. In the region, say of the lower lip, the pain may be felt in upper lip or cheek but still due to the decussation of nerve fibers (Fig. 2).

The technic that I recently devised and published (1) for injecting the buccal nerve was intended for the physician's use mainly because of his being more

Fig. 2.—Note the decussation of the buccinator fibers. This accounts for the mirrored trigger zone.

at home with extraoral procedures and is executed as follows: "The patient widely opens his mouth and a gag is inserted on the unaffected side. He is then instructed to pucker his lips, at the same time drawing the upper lip downward. This attempt makes the coronoid process conspicuous both to palpation and to vision. The needle is then inserted through the cheek just beneath the most prominent portion of the zygomatic bone, and advanced backward to reach the inner surface of the tip of the coronoid process (Fig. 3). One c. c. of alcohol I have found to be sufficient. It is certainly gratifying to see patients who have been entirely relieved in every instance in a series of fourteen cases. This statement can be vouched for by several local surgeons who have either seen the patients or have themselves made the injections. It is my opinion that injections made at the foramen ovale, although successful as far as the sensory

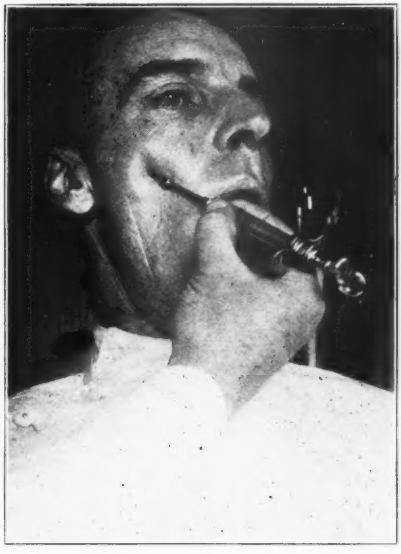

Fig. 3.—The author's technic for an extraoral buccal injection is shown above.

root is concerned, may entirely miss the motor portion, and since the buccal is a branch of the latter, the patient may go unrelieved." The intraoral technic is admirably illustrated by Arthur Smith in his book of Block Anesthesia.

Conclusion

To sum up, I would stress that proper peripheral injections give better results than the best technic for deep injections. The term "proper" may be made rather elastic and to include a host of things that are not proper. What it will certainly

not include, will be needles shorter than 42 M. M. and of larger diameter than No. 25 gauge. Nor will "proper peripheral injections" include the failure to anesthetize the branches prior to alcoholization. I believe that many failures are due to attempting these excruciatingly painful operations without first blocking with procain. And for that reason only one-half c. c. of 85 per cent alcohol is advocated for peripheral injections by some writers. This small amount I suppose because the patient often cachetic and exhausted from paroxysms will not permit of more. Then too, it is not an easy matter to visualize subcutaneously when the patient is squirming about as one tunnels through the tissues with the needle. I use one c. c. for each branch of the ophthalmic division and from one to two c. c. for all other branches. Ninety-five per cent alcohol plus a few drops of formaldehyde is used rather than the dilute.

The anatomy must be mastered and properly interpreted; such advice for instance, as Blair (7) gives for injecting the mandibular is incorrect. He advises the insertion of the needle 5 m. m. above the occlusal surface of the molars. Twice that height is the least that one would encounter the mandibular foramen or sulcus.

I will also stress that mirroring of the buccal must be looked for and treated. The cases that have dolor genetic zones, that is, where epicritic or protopathic stimulation in one branch, will yield a paroxysm in another or neighboring branch, are also to be treated. These are not uncommon and may elude the inattentive operator.

Lastly, dentists are often the first to see these cases and it is hoped that in the light of present knowledge they will not be guilty of impoverishing their patient's health and finances by instituting fruitless treatments when there are two effective means at their disposal—namely, alcoholization first and secondly gasserectomy.

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DIET AS RELATED TO THE PREVENTION OF MOUTH DISEASE

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(Read before the American Dental Association, Los Angeles, California, July 17-21, 1922)

DISEASES of the mouth include a great variety of pathological conditions. Some are of distinctly infectious origin. The cause of many is not known. However, those which interest the dentist most, are apparently of dietetic origin. Both clinical observation and laboratory study seem to confirm this. Statistics show that as there is a departure from living on natural foods, dental diseases begin.

Nor do the effects brought about by dietary irregularities appear to be wholly of a local nature—they seem to enter the field of general metabolism in which a disturbance in the calcium equilibrium occurs. In bodily metabolism, at least two things should be considered, one an ample supply of the materials out of which the various tissues are to be built up and through which their integrity is maintained, the other the ability of the organism to properly utilize these building materials.

To many, the question naturally arises how can this apply to a tooth and how can a tooth once formed, change its structure? To this question, we must reply that we do not know, but experimentally it appears to occur. The same is true of the majority of changes in other kinds of tissue. We do not know exactly how, but that they do occur is evident. We know only some things about metabolic processes, but we are gradually learning.

Perhaps we may obtain a suggestion as to how changes in teeth might occur by comparing them to bone. That the teeth and bones are very similar is well known. The inorganic constituents are chemically about the same, or about eighty-five per cent phosphate of calcium and from twelve per cent to fifteen per cent carbonate of calcium. The density of the dentin cartilage and of the tooth cartilage is about equal (1). Calcification proceeds in a comparable manner. In bone the calcium is laid down in a colloidal matrix about some of the bone cells, which forms the lacunae. In the tooth, this calcium is also laid down in a colloidal matrix about the processes of the odontoblast, thus forming the dentinal tubuli. The enamel prisms are bound together by a colloidal cement substance.

If we consider that in such a disturbance as osteomalacia or rickets, investigators (2) report that the calcium is removed from its matrix not by lactic acid, but molecule by molecule, we may reasonably feel that in caries or pyorrhea, the calcium may be removed in the same way; or, in the case of caries, that an alteration in the cement substance would permit of tooth disintegration. It has been found in the diseases of the bones mentioned, that there is an increase in magnesium (3). We have found the same thing in human teeth. Teeth in which caries has occurred show twice as much magnesium as sound teeth. This again is very significant for it must mean a change in the structure of the teeth. In the teeth of guinea pigs on a scorbutic diet, we have found three or four times as much magnesium as in normal teeth.

Caries may be a double process in

which internal or structural alterations may occur while the cavity proper may be a separate affair; we do not know. But the structure is the deciding part in the matter. The caries of childhood, adolescence, pregnancy and senility occurs during periods in which especial amounts of calcium are needed or in which the utilization of the calcium is interfered with. The changes are metabolic. Heavy tartar deposition is indicative of abnormal calcium metabolism in which calcium is being excreted into the mouth. The integrity of the oral tissues, hard or soft, and the character of the secretions of the mouth depend more upon the perfection with which the metabolic processes of the body are carried on, than upon any other thing.

It has been proven that the animal organism must have proteins, carbohydrates, inorganic salts and the three groups of unknown factors which for the present are termed vitamins.

The proteins are for tissue building. The character of these varies biologically and those that are capable of furnishing only part of the amino-acids necessary for body protein formation, must be supplemented by others that have the missing factors, as has been shown by Osborne (4) of Yale. A vast amount of literature has been compiled regarding protein requirements, but Sherman has shown that American diets are not apt to be deficient in protein. In all tissue, protein of a good quality is essential. By means of a diet of proteins alone, Osborne, or Mendel and Osborne, (5) have been able to rear animals to full growth with no evidence of acidosis.

Carbohydrates furnish bodily fuel and they are protein sparers, being utilized first. The amount needed depends upon the activity of the vital processes of the individual.

The fats also are utilized for fuel purposes and have been thought to play an important part in the utilization of calcium. Upon this subject also is an extensive literature. The taking of large amounts of fats has been thought by many to effect calcium metabolism by causing a withdrawal of calcium or by causing improper utilization of calcium, which is excreted in the form of soap. On the other hand, Holt, Courtney and Fales (6), report that the best retention of calcium occurs when a considerable amount of fat is taken. In the case of infants living on a modification of cow's milk, they found four gms. per kilo effected the best retention of calcium; for young children on a mixed diet, three gms. Fats are not always well tolerated, in which case it should be the object of the physician to increase the tolerance by the usual methods.

It is in connection with fats that the first group of vitamins appears to be associated and it has been thought that this played a part in calcium metabolism. It was, at any rate, through the character of fats that Mrs. Mellanby produced changes in the teeth and investing tissue of pups. She obtained structural changes in the teeth which showed large interglobular spaces. Loss of the alveolus and irregularities of the teeth were also produced. The animal fats are supposed to contain the fat-soluble A, while vegetable fats are not, and it was by substituting vegetable fats for animal fats, that Mrs. Mellanby obtained her very interesting effects upon the teeth and jaws (7).

The subject of fats not only runs into that of the first group of vitamins, but it also includes the subject of the inorganic constituents, in particular, phosphorus and calcium, for it was found by McCollum and his associates (8) that when a low calcium content was furnished in the diet, cod-liver oil induced a utilization of the calcium many more times than butter fat. That cod-liver oil promotes the utilization of calcium has been often remarked upon. McCollum states that this is due to some other thing than the fat-soluble A, for animals fed on cod-liver oil remain stunted in

growth, while on fat-soluble A, they grow well, other factors being present of course. He also finds that when the proper amount of calcium and phosphorus are furnished, in ample but not excessive amounts, it does not make so much difference whether the cod-liver oil or the butter fat is furnished.

Mrs. Mellanby's work was done on pups, Dr. McCollum's on rats. In the case of the human being as given by Holt, Courtney and Fales, they state that the character of the fat did not appear to matter so much in relation to its retention. McCollum, however, was producing rickets-like lesions. Pappenheimer (9) has shown that the calcium and phosphorus ratio must be maintained. He showed that whether the phosphorus was furnished as an inorganic salt or inorganic combination it made no difference in the production of rickets in rats as long as the supply was ample. He states that the fat-soluble A to the extent of ten per cent butter fat takes no part in this. With low phosphorus he shows that twenty minutes' exposure to sunlight daily prevents rickets in the rat. All of which goes to show that an ample supply of calcium and phosphorus is the important thing in rickets. Blood examination in rickets does not show a low calcium content, while it does show low phosphorus so that this disturbance appears to be one of irregular phosphorus metabolism. Sherman has again found that American diets are not very apt to be deficient in phosphorus.

Grieves (10) has examined the teeth of the experimental animals of McCollum and reports carious-like lesions together with other dental disturbances, which is to be expected if the teeth were not fully calcified at the time when the experimental feeding was begun, for of course, the bony tissues cannot be properly formed if there is a shortage of the materials out of which they are to be built up. If the teeth of these animals were already formed, the results are interesting for they show that in the event of a deficiency of calcium for bodily maintenance, the calcium is withdrawn from the formed tooth, which confirms ideas that I have already given many times as a result of my own experiments (11).

Again referring to the work of Holt, Courtney and Fales, it is to be noticed that they state that the best retention of calcium occurs when infants receive .190 gms. per kilo, and young children .180 gms. of calcium oxid per kilo. These figures are higher than have been thought necessary to fulfill the requirements. However, the needs of the growing child for calcium can be realized when we consider that he has his bony framework to build. Now Sherman has shown that American dietaries are deficient in calcium in the proportion of about one to six for the adult. How much more then are American dietaries deficient for the calcium requirement of children whose growth factor must be considered!

Of the two groups of vitamins, water-soluble B and C, it may be said that the group B is directly associated with the production of beri-beri. It seems to have two properties, an antineuritic property and a growth promoting property. Whether the latter is a distinct property or not, this accessory food substance has a marked effect in increasing the appetite. It is due to Funk (12) that this substance was discovered and the work upon it elaborated. Its effect upon bones or teeth has not been noted as yet.

The antiscorbutic is the one that we have particularly studied and have reported upon. In our experiments, we have endeavored to obtain a latent but definite effect extending over a long period of time. The dental effects have been very decided as you know. The work has been mainly done on guinea pigs, but is now being carried out on monkeys. While it is too early for a report upon these latter animals, I may say that they have developed symptoms identical with the scorbutic conditions in guinea pigs. Profound joint trouble,

severe eye disturbances, loosening of the teeth, periodontal disturbances from slight gingival redness to almost entire destruction of these tissues, have occurred. The jaw has become extensively decalcified, and in one or two of the animals that died, enamel changes in the lower first permanent molars is apparent; each molar had a distinct cavity identical with human caries. Another animal also has a cavity in his lower first permanent molar. This animal has shown scorbutic symptoms for about seven months. In the other, no caries was found for he had shown scorbutic symptoms for only about three months, which is too early to expect caries in teeth like the monkey whose dental development is rather better than that of the human being.

There has been some criticism of this work which I believe should be answered. First, it is stated that too much attention is being paid to the vitamins and not enough to the calcium and protein requirement. The calcium and protein are of course essential and no one engaged in such work would think of neglecting these factors. In my work, these have all been given in proper amounts. The standard or basic diet has been referred to Dr. McCollum and he has been kind enough to alter the proportions of it so that he considered it as nearly correct as is known how to make it.

It may be that in the case of the fat-soluble vitamin, that this may have been over-emphasized in irregular calcium metabolism, as has been shown above. We have always remarked upon the importance of calcium in this connection and have given again and again the figures quoted above as to the needs of the body for it and pointed out that in pregnancy and childhood, the need is unusual. We have called attention to Sherman's (13) estimates and conclusions in regard to this. He shows that American diets are not so apt to be deficient in phosphorus as calcium.

The profession has been warned against reaching conclusions regarding scurvy as produced in the guinea pig. Work upon guinea pigs and upon the dog has been regarded as of very questionable character, the rat being regarded as the suitable animal. It has been said that the guinea pig has a gastro-intestinal apparatus suited for bulky succulent diets and cannot be compared to man. Now it is perfectly well understood that the work upon any of the lower animals can only be regarded as suggestive. One kind of animal is chosen for one kind of study, another for another. As far as these two animals are concerned, the rat is not subject to scurvy; man is, as is also the monkey, and the guinea pig. In all three, this pathological condition has been shown to be the same. Inasmuch as the rat shows no scorbutic effect and as scorbutic effects in man effect bone changes and dental changes, we can only conclude that the calcium metabolism in rats cannot be compared with that of man except with large reservations. But in the guinea pig and the monkey, we can obtain identical effects with that of man. These are practically the only animals that show scorbutic effects and they have been used in all work upon this subject (14). What animal in their experience in this kind of work, would these critics suggest that we use?

With reference to the gastro-intestinal tract and diet of the guinea pig as compared with man, we will say that we have a number of these animals that never had any succulent foods since they were born. They have grown to maturity on just such a diet as man is capable of living upon and they weigh about 1200 gms. They have also reproduced on this diet. They require the same food elements as all animal organisms, the only difference being in inert material for bulk. They will not thrive on green succulent foods alone. With regard to the teeth of these animals, I will say that both rats and guinea pigs are rodents and that while the molars of the rats

may be somewhat more nearly like the human, in both there is considerable difference. We have therefore chosen to work upon the monkey whose dentition is the same or better than man's and with identical lesions appearing, especially caries, we can only feel that these cautions are uncalled for.

That the antiscorbutic vitamin has a most profound effect upon calcium metabolism in man is not to be doubted. There is ample evidence to show this. That scorbutic effects identical to that in man may be produced in the lower animals capable of showing these effects, we have many specimen to show. Even when all the necessary elements are furnished, the calcium is not only not utilized but it is withdrawn from the bones and teeth. We may feed an animal whole grains, fats, proteins, inorganic salts and the other two vitamins, and one that is capable of showing scorbutic effects will die, but sprout the grain, and feed him this in addition, and he will live. There is something that is to be found in the vital process of the sprouting grain that possesses this antiscorbutic property.

Parkman in his "Oregon Trail" tells of the Indians, after killing many buffalo, eating the raw meat. This is a source of antiscorbutic vitamin. Stephanson describes curing his scorbutic men by feeding them raw meat. Raw or fresh frozen meat contains antiscorbutic substances. Fresh raw foods that contain calcium or those that modern diets are apt to be deficient in are to be especially recommended.

Unquestionably a latent, recognized, scorbutic condition exists very extensively. Zilva (15), has called attention to this in his work with Wells. This may be readily seen when we recall the fact that the antiscorbutic vitamin is the one most readily destroyed. Cooking, drying, refining, fractioning, pasteurizing, and the long keeping of food, results in the loss or destruction of this factor. So common is the effect of this food deficiency, that it has become common practice to feed antiscorbutics, such as orange juice, to all infants that are fed pasteurized milk. This is at a time in life when calcification of the teeth is in progress and therefore a matter of great moment to the dentist in his endeavor to obtain caries-free teeth. Not only is the antiscorbutic vitamin destroyed in cooking, but the water is often thrown away and this containing much of the inorganic salts. This should be saved and made into soups. It is during prenatal life, infancy, and young childhood, that we must endeavor to have sufficient calcium fed, and to attempt, in so far as we understand it, to induce the proper utilization of the calcium. Mother's milk is the best thing for infants. If the milk is of poor quality, an effort should first be made to improve this by a better feeding of the mother. If it is necessary to artificially feed the infant, then a modification of cow's milk is advocated. On account of the fact that cow's milk forms hard curds, encasing more or less of the calcium, and that this is excreted, an especial effort should be made to have this calcium in an assimilative form.

Calcium is found in milk and in the green leafy vegetables. The antiscorbutic vitamin is also found in these foods when they are raw. Both are the substances in which modern diets are apt to be deficient. Both are essential for the formation of sound teeth and in addition to our regular foods are recommended to be taken with regularity.

Caries of the teeth has followed a departure from living on natural foods as has been repeatedly shown, and we must return in a measure to living upon such foods. We should at least have an understanding of food requirements and food effects sufficient for us to intelligently select from the great variety of modern foodstuffs, such as will prevent the very profound tissue changes that follow a protracted deficiency in the elements mentioned in this paper.

Broderick's (16) idea is that caries is due to deficiency of the endocrine glands. The part played by the derangement of these glands in calcium metabolism, is generally admitted, and it would seem in specific cases, that caries might be explained in this way. It is however, well known that in feeding experiments of the type mentioned, atrophy of these glands occur. It would therefore seem to be in such an extensive or almost universal condition as caries, that even if endocrine disturbances are equally common, the fundamental cause might still be the diet.

In this connection, it might be again mentioned that the salivary glands at least partially atrophy in these experimental animals, as we have found by sectioning them. Reproduction is also stopped, and it may be brought about again by correcting the feeding, showing that the organs of generation are greatly influenced by the diet. The production of monsters when the pregnant mother is improperly fed for a short time is also very significant of the far-reaching effects of a slightly deficient diet that is continued for any length of time. Among our animals, we have had animals with no eyes, animals with only one eye, or both eyes formed but one sightless, and animals with malformed feet. One gave birth to an enormous fetus born dead. It is therefore entirely possible that when such profound changes may be made to occur, endocrine deficiency may be of very common occurrence as a result of improper feeding.

The ideas of Pickerill (17) are that caries is of lactic acid origin. He has advocated the use of sapid foods with the object of increasing the total alkalinity in the mouth. Most of the foods he recommends are calcium containing and contain the antiscorbutic vitamin.

Our present methods of prevention are reparative and of a temporizing nature. They are excellent. But the fundamental cause lies deeper. We are dealing with symptoms both in caries and in pyorrhea, as any physiologist will agree. To actually check these dental conditions, we must enter the complicated field of general metabolism. The two factors we especially need to observe is an ample supply of calcium and food substances that induce its proper utilization.

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THE PRESERVATION OF THE DECIDUOUS TEETH WITH SPECIAL REFERENCE TO THE MAINTENANCE OF FUNCTIONAL DEVELOPMENT

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(Read before the Chicago Dental Society, March 20, 1923)

THE significance of the deciduous teeth is becoming more and more apparent as we go deeper into the well-laid scheme of nature when she planned to have this set as the precursor of the permanent teeth. Manifestly this plan was necessary when we consider the relative difference in the size of the jaws of a child and the aggregate width of the permanent teeth. Some arrangement had to be made whereby the growing child might have a masticating apparatus during the period of his early development, and there was assuredly not room in the small jaw to accommodate the teeth of the adult.

The fact that the deciduous teeth were to be lost in a few years has led many parents of children into the grave error of supposing that their function was a minor one, and that their sole significance relates chiefly to giving the family circle a prolific topic of conversation whenever the baby cuts a tooth. Incidentally there may occasionally be found away back in the brain of the parent a vague idea that these teeth were intended to help the child prepare his food for digestion and assimilation, but that is the utmost of what the average parent ever thinks in connection with the deciduous teeth. And the question may be asked—how has the parent gained this narrow conception of the value of these teeth? Primarily all information connected with dental matters must come from the dentist, and so this idea has been given to the people by the members of our own profession. In fact there are dentists today—very many of them—who hold this circumscribed and erroneous view regarding the function and significance of the deciduous teeth. Patients report almost daily who claim that they have been informed by their dentist that in view of the early loss of the deciduous teeth there was really very little incentive to save them, and that any attempt to do so was in a large measure "love's labor lost."

The damage that has accrued to many a child through this mistaken point of view can never be estimated. If Nature did not intend that these teeth should serve a useful purpose from the time of their eruption to the appearance of the permanent set, why did she develop them? It is always a perversion of Nature when they are lost before their time, and always a detriment to the child. This careless and mistaken policy of underestimating the deciduous teeth on the part of our profession must be reformed else we may not stand before the people with a clear conscience.

If the keynote of the hour in dentistry is the question of prevention, there is surely no other time so propitious as youth for the exercise of this idea. Someone has said that if we wish to reform humanity we should begin with the grandparents, and another observer has stated that we should go back five or six generations. Unfortunately in the present connection you and I have very little influence with these remote ancestors of our patients. We do not come in very intimate contact with them. But we are today coming more and more in contact with the present generation, and in the main, children are being brought to us earlier in life than they formerly were. We, therefore, must make the most of our opportunities and grapple with this question of dental disorder in an earnest and devoted manner, so that we may at least feel that we have done our whole duty.

It is not within the province of a single paper to detail all the various evils which may result from a premature loss of these teeth, nor have I sufficient scientific knowledge to elucidate certain phases of the subject, particularly that related to the lack of proper development of the dental arches as it affects the science of orthodontia. But the general practitioner may well take the word of the specialist in this regard, and cooperate with him sufficiently to abstain from giving patients false information which inevitably leads to trouble and deformity in the future. It does not require the prescience of a specialist to visualize the gross results of perverted function on the development of the jaw of a child when the stimulating effect of mastication is removed from it. Of all the periods of life, no other is as important as youth, so far as the necessity of the maintenance of function is concerned. Function and growth are synchronous during these developmental years, and we are playing with a sacred provision of nature when we carelessly or indifferently neglect the prime means of maintaining function. Never has the profession erred more egregiously or sinned more generally than it has in ignoring the real purpose of nature in supplying the child with a set of deciduous teeth. Unless we are willing to spurn nature with a high hand, we shall revise our ideas on this subject, and shall take the same solicitous care of these teeth that we do of the permanent ones.

Aside from the lack of development of the jaws and the consequent irregularities of the permanent teeth through early loss of the first set, there is another factor in the case which must appeal to every thinking practitioner. We all know the evil effects of faulty mastication, particularly in early life, but that does not tell us the whole story of the ills that may follow a breaking down of the temporary teeth. It is with these teeth that the child is supposed to learn to masticate. If they are kept intact and the child is given the proper kind of food he is quite likely to acquire good habits of mastication. It is natural that he should do so. But in the event of neglected cavities in the teeth, what happens? If decay attacks a tooth on one side of the arch so that there is discomfort in mastication the child intuitively passes the food to the other side, and does not masticate on the affected side. If a cavity occurs on both sides, as is so frequently the case, the inevitable result is that the child does not masticate thoroughly on either side, but bolts the food without mastication. The evil effects of this do not confine themselves merely to an indifferent preparation of the food during childhood, with all of its attendant evils, but to a

possible far-reaching effect that may last a lifetime. We all know the readiness with which children form habits—it is proverbial. What then is more logical than that this child, condemned by our neglect to abstain from thorough mastication, should form indifferent habits of chewing, which will extend on into mature life? Watch the average group of people in a restaurant or dining car, and observe the varying degrees of thoroughness with which they masticate their food. This variation is not due solely to the fact that some have teeth and some have not. Most people today in the walks of life which we are considering have comparatively well-equipped mouths for mastication, either in the complement of their natural teeth or in artificial restorations. This variation then in the thoroughness with which different people chew their food must be attributed to habit, and in all likelihood a habit that was formed in childhood. We never know the far-reaching effect of our neglect when we permit a child to develop caries in his deciduous teeth to the extent of making them uncomfortable for mastication.

To be sure, it is not invariably the fault of the dentist that deciduous teeth are neglected, except in an indirect way. Many parents allow these teeth to go till it is too late for the dentist to accomplish much for them, and the only responsibility the practitioner has in the situation is the general fact that the profession as a whole has been remiss in not educating the people as to their significance. Dentists should be alert and pass the message on in every way possible so that the present misconception shall be dispelled, and parents be impressed with the necessity of bringing their children to the dentist earlier. If this is done and the practitioner does his duty most deciduous teeth may be preserved in functional efficiency till they are lost through the natural process of exfoliation.

It may be appropriate to consider for a few minutes some of the procedures which are necessary in the management of these teeth when they come to us decayed. The problem is a slightly different one from that presented by decay of the permanent teeth. In the latter case the aim is to make operations which will last for many years, while in the former it is a matter of so managing the teeth that they may be saved in a serviceable way till such time as they are displaced by the permanent set. Usually it is only a matter of five or six years at most. And yet it must not be thought that this service is always a simple one. There is probably no condition in the general conduct of a practice that calls for more ingenuity, patience and skill than the saving of the deciduous molars when they have once been deeply invaded by caries. The problem is two-fold—to manage the teeth and manage the patient, and often the latter is more difficult than the former.

In these cases we are constantly sailing between the Scylla and the Charybdis—the danger on the one hand of breaking down the courage of the child and developing a dread of dental operations, and on the other of doing work which is not sufficiently permanent to serve its purpose. Every operator must study this problem in the light of his personal experience, the only insistence being that he does study it. Fortunately today there is not the widespread fear of dentists on the part of children that existed in the past. It was formerly the rule rather than the exception for children to be brought to the dentist for the first time in a state of undue trepidation.

It was apparently the great American

pastime for the elders to regale the children around the family fireside and at the table with the most gruesome tales of what happened to people when they went to the dentist, and the little impressionable minds readily pictured the horrors of the "Inquisition" as associated with every dental office. Happily today this is changed. Parents have learned the folly of prejudicing children in this way, and thus one of the great handicaps to their successful management is removed. But at best it is still a problem. These little teeth are sometimes sensitive, and it is not always possible to accomplish the most satisfactory work.

Probably the class of cases which give the greatest trouble are proximoclusal cavities in the molars. Simple occlusal cavities are usually easy of management, but when the proximal surface becomes involved, it introduces several factors which complicate the situation. First is the fact that the pulps are relatively large in these teeth, and a cavity does not penetrate very far without approaching the pulp. Then the problem of anchoring the filling is sometimes difficult. Fillings in this situation are subjected to all the stress of mastication, and perfect cavity preparation is not easy of accomplishment. The maintenance of the interproximal space is also an important matter for consideration. Children frequently complain of their teeth hurting them when they eat, due in most instances to the wedging of food between them; and if this is not remedied the child intuitively begins to keep the food away from that region of the mouth, and mastication is to that extent impaired. Altogether the problem of saving these deciduous molars when they have become decayed is not an easy one, and yet it can be done in most instances with the co-operation of the parent and the dentist.

While this paper is primarily not one of technic, yet it may be profitable to consider briefly the question of filling materials for deciduous teeth. This is one of the dilemmas of the situation. It is sometimes difficult to select a suitable material to manage these cases. In all simple occlusal cavities where the pulp is not approached the chief reliance is on amalgam, and it serves a most useful purpose in these places. It should also be used in all proximal cavities where anchorage may be had and the approach to the pulp is not dangerous. But here is the rub. In too many cases thorough cavity preparation is almost out of the question, and even if the cavity could be prepared properly, there is always grave danger of the pulp dying under an amalgam filling if it comes near the pulp.

In many of these cases the best purpose is served by using a temporary material, such as guttapercha or oxyphosphate of zinc or oxyphosphate of copper, till such time as the danger of irritation to the pulp is past. But herein is presented another dilemma. Too frequently the patient is allowed to go with these temporary materials so long that they are completely worn out, and decay recurs, with the inevitable further complication of the case. In too many instances the moment the child is comfortable no further thought is given the teeth, and unless the dentist checks upon it himself "the last condition of that case is worse than the first." If these teeth are worth saving at all, they are worth a whole-hearted effort, and not mere perfunctory or slipshod attention. The only safeguard is an insistence on seeing the child at stated intervals—the time to be set by the dentist, and notification for examination to be sent from his office. In this way control of the case may be assured.

One of the most complicated condi-

tions to successfully treat relates to those cases where two proximating cavities occur in molars, and the necessity arises for building the fillings out into contours. To maintain such fillings against the tipping stress of mastication is sometimes difficult, and the case is further complicated by the fact that in some instances there is quite a wide separation between the teeth due either to the packing of food between them, or to the natural enlargement of the arch in the process of development. Usually the gum tissue has grown into these cavities, and the first problem is to get it out of the way. This can be accomplished most successfully by the use of guttapercha, leaving it in for a day or two, when the gingival margin of both cavities will be found perfectly exposed. Then comes the decision as to the selection of filling material. In all cases where the approach to the pulp is not too close amalgam is our chief reliance, usually filling one cavity at one sitting and the other at another sitting. If the pulp is nearly involved so that amalgam is contraindicated, resort must be had to one of the cements, preferably the oxyphosphate of copper. This material, while unfortunately intensely black, has quite a wide range of service in the management of deciduous teeth. And yet the fact must be faced that with this as with the oxyphosphate of zinc we are dealing with a material which is essentially temporary in character, and our only justification for using it is that we are compelled to do so by the exigencies of the case. It will require renewal at stated intervals which, after all, is not such a very serious matter, provided the patient is faithful in reporting for inspection. Above all things, the teeth must be kept comfortable for mastication, and the child free from pain.

Another condition connected with this class of cases, just the opposite of that referred to, is where the teeth instead of being widely separated have dropped together, thus narrowing the interproximal space. The most effective way of managing these cases is to pack pink base plate guttapercha into the cavities, extending it across from one tooth to the other, and instructing the patient to masticate on it. This will most effectually separate the teeth and cause the needed pressure on the arch to encourage its proper development. In fact, it will be found in practice that in some of these cases of constricted arches a very material aid to expansion may be found in this use of guttapercha, and its employment for this purpose is very strongly urged in all those instances where constricted arches are accompanied by cavities in the proximal surfaces of the molars. Sometimes lifting these teeth apart for only a short distance by this means will so change the relation of the occlusal planes of the cusps that the arch will be sufficiently expanded by natural processes. In doing this one precaution is necessary. A guard should be placed over the gum tissue in the interproximal space to prevent the guttapercha from being forced far between the teeth, so that the gum is completely crushed out of the space. The making of this guard is a very simple matter. A flat strip of copper or German silver about two or three millimeters wide may be cut to a suitable length to extend across the interproximal space, with one end resting on the gingival wall of one cavity and the other on the gingival wall of the other. This when laid over the space with the ends looking mesially and distally, will form a guard against which the guttapercha may be packed with the positive assurance that the guttapercha will not be crowded too far rootwise. Under these circumstances a

guttapercha filling may sometimes be worn for months, with the result that the teeth have been slowly separated and meanwhile have been kept comfortable for mastication.

But the most disheartening cases of all are where the teeth have been so neglected that decay has encroached on the pulp and caused its destruction. The management of pulpless deciduous teeth is at best experimental. In some cases they respond so promptly to treatment that there is no shadow of doubt as to the advisability of retaining them; in others they are so stubborn that the only recourse is extraction. And of course extraction means loss of functional development. The conscientious operator is sometimes lashed between the desire to maintain the integrity of the arch by the retention of the deciduous teeth, and the danger of leaving teeth in the mouth which are not healthy. In all such cases there should be no hesitation about what shall be done. If a tooth cannot be made safe by treatment it must be removed. But many of these apparently doubtful cases are amenable to successful treatment, and thus we should not throw up our hands merely because a deciduous tooth becomes pulpless. The child is entitled to the effort being made to save the tooth, and the tooth should be given the benefit of the doubt.

Time will not permit a discussion of the treatment of deciduous pulpless teeth except to say that no powerful drugs should be used. Under no circumstances should arsenic ever be applied to a pulp or fragment of a pulp in a deciduous tooth. It is dangerous and wholly uncalled for.

The entire question of the management of the deciduous teeth resolves itself to a constant supervision of all susceptible cases, and to a consecration in every case to the future welfare of the child. These little boys and little girls have been placed in the world for the furtherance of the great scheme of human development. Let us see to it as a profession that we do not lightly absolve ourselves from the sacred obligation of doing all in our power to give to each one of them a fair chance in life so far as efficiency is concerned. No child can be efficient who is handicapped by dental disease or deformity, and no child should be condemned to grow up with this handicap. It is your duty and mine to devote our best energies to the welfare of the rising generation in so far as that welfare is affected by conditions in the mouth. To do less than this is a perversion of our professional birthright—to do all of it wholeheartedly and conscientiously is to achieve the chief glory of our professional existence.

Discussion

Lloyd S. Lourie, Chicago, Illinois: Dr. Johnson spoke about preservation of the deciduous teeth with special reference to function. I wish you to carry that thought home with you even if you forget some of the other things he said. Maintenance of function is the purpose of dentistry always. For the child, it is particularly important that function be maintained because of the influence on development.

The time is rapidly passing when dentists may be excused for failure to know and to advise along the lines mentioned. The clean teeth idea is well started among the school children and it should not be long before the laity generally should be prepared to appreciate the value of preserving the deciduous teeth. In fact, the profession will have to hurry or it will be following a demand instead of pointing the way. Recently a school nurse complained to me that it was hard to get co-operation from dentists when deciduous teeth require attention.

It should be an interesting study and field of service, this supervision of the developing dentition, and I cannot help but feel that the financial consideration is an important factor in its unpopularity with the profession. People seem to have the notion that anything for a child should cost less than for an adult, and no general or concerted effort has been

made to prove that this is not the case concerning dental services. The public must be shown that money spent on the deciduous teeth is a good investment saving many times as much which would otherwise be spent on the permanent teeth. Also, they must understand that at times this service for children is more difficult than for adults, and worthy of a larger fee. Possibly some of our "business side of dentistry" propagandists can arrange a campaign to "put over" these ideas, but meantime individual effort is necessary.

Regarding operative work, it will be a great assistance to functional development if children's teeth are kept comfortable, allowing the development of function, but full dental assistance will not be given unless fillings really restore lost tooth form, particularly mesiodistally. Shortening of a lateral half of the dental arch by even one millimeter may result in malocclusion of the first permanent molars on that side.

How long should deciduous teeth be preserved? If more interest was taken in children's teeth we might have more reliable data on the subject. Tables are not dependable, but each case should be considered on its own merits, and the state of development of the individual more than the age of the child.

Another thing of interest would be a discussion of the methods of gaining the confidence of children and in handling them. I believe one important thing in dealing with children is not to baby them, but treat them as if they knew something and can appreciate what you are telling them, and take a little time to satisfy their curiosity about things and get acquainted with them. Time taken in that way is well spent.

In conclusion, let me say that I believe that dentists who avoid children are missing a good tonic influence and some enjoyable companions.

F. Blaine Rhobotham, Chicago, Illinois: I believe we can turn out in the future, dentists who know how to take care of children's teeth better, and will be inspired to do so, if the dental schools will do their part, and I believe they will. That is a fundamental way of correcting the situation for the future, but it will be a long time before that comes about. For the present a few suggestions might be made. One suggestion is in having this subject brought up regularly before dental societies and keeping it alive before the profession. Another is in having talks made regularly to public health nurses that they may carry the good news to the people they serve.

Another excellent method is to have oral hygiene taught in our public schools. Still another method, and perhaps one that reaches parents more directly than any other, is in arranging talks before parent-teachers associations.

Dr. Johnson (Closing): I want to thank those who have taken part in the discussion. Please remember what Dr. Lourie has said regarding the influences that may be brought upon those who come in close contact with children. I also want to second what Dr. Rhobotham has said. If we have frequent agitation of this question, I do not believe the profession is going to be as remiss in the future as it has been in the past. I look upon this as the fundamental basis of future success in dental progress. We should get the children early and appreciate the significance of dental service to them, and further we should devote ourselves faithfully to the rendering of that service.

THE RELATION OF FOCAL INFECTION TO SYSTEMIC DISEASE

By WM. G. ALEXANDER, B.S., M.D., Evanston, Illinois

(Read before the North Suburban Dental Society, Evanston, Illinois, January 8, 1923)

MY HOPE is to get co-operation between the three groups of men—the dentist, the physician and the radiologist. Each has his part in this problem and yet no real progress has been made until the three were brought together either as three individuals or as occasionally some man combines the education of two of the three branches. Probably the ideal combination is one that has the teaching and experience of all three in one person, but these are extremely rare.

One need but go through the periodicals in dentistry, medicine and radiology and observe the large percentage of the articles that bear directly upon the subject to realize the interest it is causing, or to notice the names of men like Miller, Poynten, Paine, Lambert, Hunter, Billings, Rosenow, Hartzell, Larson, Grieves, Vaughan, Gilmer, Moody, Duke, Logan, Black, Noyes and a host of others to realize the importance of the subject.

The points where focal infection may exist are numerous, but the principal ones in the order in which they probably occur are: Tonsils, teeth, intestines, gall-bladder, urinary bladder, and numerous locations of less importance.

The most common systemic disorders have been summarized probably best by Llewellen Barker (1) as follows:

The Locomotor System: Infectious arthritis, hypertrophic osteoarthritis, osteomyletis, and myositis (muscular rheumatism).

The Respiratory System: Antrum infection, laryngitis, embolic pneumonia, infected tonsils and pleuritis.

The Circulatory System: Endocarditis, pericarditis, myocarditis, cardiac irregularity, arterial hypertension, arteriosclerosis, and angina pectoris.

The Blood and Blood-making System: Achylia gastrica, relationship to gastric and duodenal ulcer, inflammation of the liver, and inflammation of the pancreas.

The Urogenital System: Nephritis, pyelitis, cystitis.

The Nervous System and the Eye: Peripheral neuritis and neuralgia, neurasthenic states, and recurring iritis.

The Endocrine System: Relationship to hyperthyroidism and undernourishment.

Barker is recognized as a conservative writer and yet we note that he includes a very long list of diseases as above. The relationship between local foci and general involvement of the body by secondary invasion was noticed by a few early observers, but the first real suggestion probably came from William Hunter in 1900. Later came the monumental work by Billings and his coworkers in 1910-1916. Notable among these was Rosenow, whose experimental work has been at times almost uncanny.

Much work by the other men named has followed until today the relationship between the original infective focus and the final systemic disease has been thoroughly established. The problem is a big one and like all such problems has many angles to it. Some of these angles may not be clearly seen by us at all times so that we must not place ourselves in any smug attitude of mind and feel secure, for we may suddenly find ourselves far behind in the forward march of progress. More real progress has been made in dentistry in the past ten years than twenty-five years before. The dentist who feels that his work is limited by the pure mechanics of the teeth and does not see that the dental problems are far-reaching and have a distinct bearing upon the general health of the patient is no longer a safe dentist and you would not employ him. And on the other hand, the physician who treats symptoms of patients and does not make every effort to locate the hidden cause behind them is so far behind the game as to be absolutely an unsafe advisor. I want this paper to at least accomplish one result—to set us all thinking how we may come together even closer in the study of local and general disease.

I want to give you some of the facts brought out by the most recent researches made under the observation of Rosenow of Rochester, Minnesota, in connection with the cause of gastro-intestinal diseases. He shows that the site of localization is determined by the nature of the organism—the pneumococcus in the blood localizing in the lungs, the typhoid bacillus in the blood localizing in Peyer's patches in the colon, the streptococcus viridins from septic endocarditis localizing in the heart lining, and so on. Hence the relationship between the streptococci in the teeth and tonsils which have a tendency to pass through the blood and localize in the mucous membrane of the stomach and the ulcers thereby produced. His earlier work showed: sixty-eight per cent of animals injected with strains from appendicitis cases developed hemorrhagic appendicitis as compared with three per cent in animals injected with strains from other sources; sixty per cent injected with strains from ulcer of the stomach or duodenum developed ulcer as compared to seventeen per cent from other sources; eighty per cent developed gall-bladder infection from strains grown from infected gall-bladder as against four per cent from other sources. He was able to show that acute attacks of appendicitis followed many exacerbations in the teeth and tonsils. It is a clinical observation by other workers that appendicitis is more common during epidemics of sore throat and that there is an increase in incidence of gastric ulcer during the months when throat infections are most common (Moynihan).

In some recent experiments Rosenow has shown in a series of sixty-five animals (fifty-nine rabbits, four dogs and two guinea pigs) which were injected intravenously with the cultures from nineteen cases of ulcer of the stomach or duodenum, thirty-two injected with cultures from the tonsils, six with pus from the tonsils, seven with streptococci of excised ulcer, and twenty-three with cultures from infected teeth, that the incidence of ulcer was about equally high in all the groups—that 80 per cent of the animals developed ulcer of the stomach while lesions in other organs were absent or very slight. He showed that all of the animals injected with the pus from the tonsils developed striking lesions in the stomach. He cites the case of a patient with recurrent ulcer with hemorrhage who had dental infection. A gastroenterotomy had been performed twelve years previously. No attention had been paid to the dental condition at the time. After

the removal of five infected teeth when the ulcer had recurred the patient's symptoms gradually subsided, although previously the condition had not responded to treatment. The streptococci taken from the granulomas of three teeth and from one devitalized tooth were injected into four rabbits. Forty-eight hours later all showed hemorrhages and ulcers of the stomach. Three of the four rabbits showed hemorrhages and edema near the roots of the lower incisors.

Again another patient was reported as having shown gall-bladder and pancreatic findings associated with infected teeth and tonsils. After removal of both foci the patient recovered. The primary culture from the tonsils was injected into one rabbit and three dogs. Forty-eight hours later examination of the four animals showed definite lesions of the gall-bladder and pancreas. The streptococci from the fluid surrounding the pancreas was then injected into a dog and a pregnant cat. Marked gall-bladder lesions developed and the cat aborted and one fetus showed hemorrhagic fluid around the pancreas and definite involvement of the pancreas itself. Cultures from the pancreatic lesions in the fetus, from the gall-bladder and pancreas of both cat and dog, yielded streptococci. These are facts and not theories.

Let me give you a few facts about the so-called "epidemic hiccough" which occasionally appears as a very troublesome illness. Rosenow found in a study of this subject that the tonsils contained considerable pus as well as the finding of several pyorrhea pockets. Suspensions from these pus-containing organs were used as inoculation material in animals. After a period of incubation of one to seven days a remarkable train of symptoms developed, in which rhythmic clonic spasm of the diaphragm occurred with a persistent hiccough.

The relationship of focal infection as regards muscular rheumatism and arthritis has been thoroughly studied by Billings and his latest report is contained in an article in the *Journal of the American Medical Association*, April, 1922. I wish to quote some of his statements and statistics based on his records and findings in 411 patients suffering from chronic arthritis and chronic muscular changes. He tabulates the primary sources of infections as finally determined, as follows: Tonsils, 336; teeth, 136; sinuses, 12; bronchi, 5; uterus and tubes, 12; prostate gland, 24; gall-bladder, 3; colon, 2; appendix, 1, and middle ear, 1.

He emphasizes the fact that the location of the real focus was occasionally difficult and sometimes impossible and that in some patients the failure to eradicate completely the etiologic focus by surgical measures had defeated the subsequent management and treatment, illustrating the latter by the histories of two patients—one of whom had a severe chronic arthritis and myositis, who showed infected tonsils and apical infection at some of the tooth roots. Both of these were removed with immediate partial recovery, but relapses followed. Later both developed gallstone symptoms, were operated and were completely and permanently relieved of the arthritis.

Another illustrative case showed infected tonsils and teeth, which were removed with partial relief only. Later, after appendectomy, recovery was complete.

We are seeing these cases more or less constantly and they illustrate well the need for careful examination to locate all the possible foci that exist, if this be possible. There is no question that infected tonsils and teeth may become sources of trouble independently of the other focus and should be removed before they are potent factors of future

ills, but they may not be the direct cause of the systemic condition present. Of course, we must not forget that the teeth and tonsils may have been the original hotbed from which arose infection in the gall-bladder and the appendix, and in a sense they are the real primary foci of the infection. In the same manner the primary focus may lie in the teeth, secondarily locating in the joint and a third infection in some other portion of the body may occur. So long as the joint remains infected, removal of the teeth will not cure the last infection.

In connection with the anatomy of the teeth one must consider the lymphatic system of that neighborhood. The most complete work on this has been done by Frederick B. Noyes (2). His work was done in 1914 and is especially valuable in demonstrating how infection in the gingiva can be transferred to the pulp and thence through the apex to the general system. I quote from his article:

"The latter (the lymphatics from the deep gingival spaces next to the teeth) penetrate the ligamentum circulare and extend toward the apex of the root in the periodontal membrane.*** The connective tissue accompanying the blood-vessels and nerves is seen to contain many injected lymphatic vessels. These continually anastamose with vessels in the spaces of the bone. At the apex of the root the vessels anastamose with lymphatic vessels which accompany the blood-vessels through the foramina in the cementum into the dental pulp. On reaching the pulp chamber the lymphatic vessels are either perivascular or independent. The material seems to show that most of the large blood-vessels in the central portion of the pulp have perivascular lymph sheaths; but there are also good sized lymphatic vessels lined with endothelial cells independent of the blood-vessels.*** The lymph vessels from the dental pulp pass through the apical space into the spaces in the bone, anastamosing with the rich lymphatic network in this tissue. The vessels then pass to the periosteum but drain through the inferior dental canal in the lower jaw and in the infraorbital canal in the upper jaw. Here they form a rich plexus around the blood-vessels and in the sheaths of the nerve trunks. The vessels pass out of the mental and infraorbital foramina, pass in a superficial course, and follow the facial artery and vein, passing to the large submaxillary lymph nodes." Thus we see the connection of pyorrhea and apical abscesses and the real danger of general infection from such foci.

Grieves (3) is a well-known authority and he sums up the classification of pathological tooth conditions in relation to disease in as fine a manner as any article that I have chanced to see. He starts out with a most startling statement for one dentist to make to a group of dentists when he offers his reason for presenting a classification of dental pathology and goes on to say that the classification "must be accepted as a clinical presentation only, for, as the matter now stands, it is next to impossible for dentists to consult intelligently among themselves upon the subject. How then," he adds, "can they expect their medical confreres to comprehend in oral pathology what, to their own minds, is not clear?"

"Is it any wonder," he continues, "that our medical confreres, not understanding, condemn all 'filled pulpless teeth', overlooking any others more virulently diseased, and doubt the judgment of any dentist who honestly insists that certain types of diseased teeth are both harmless and functional, hence should be retained?"

Continuing, he says: "Any intelligent discussion of this subject is necessarily based upon certain facts, which must be considered axiomatic, even though subject to correction in the light

of the constantly accruing results of research, like all other scientific data. Upon such clinical axioms we must all agree; just as we accept and apply treatment to that disease entity known as dental caries, while disagreeing as to its etiology. These facts should be couched in the language common to general, not merely to oral, pathology, so that all pathologists may understand when we speak of the etiology and pathology of pulpal and apical diseases, all of which, if properly classified, would indicate the correct treatment and prognosis. Not only would this course greatly clarify the subject in our own minds and save countless, otherwise functional teeth, but it would promote a better understanding, and closer cooperation, between both dental and medical professions."

This sounds like good sense and I am sure that what he says about the lack of common ground for the dentist is just as much true for the physicians in their ideas of what should be done with teeth. We must get some common understanding in the matter for the question is too large and the results too far-reaching for it to be overlooked. Grieves makes the following classification:

Class I. Average teeth, pulps vital—neither pulpal nor apical symptoms. May be carious or filled—coronal dentin infected but pulps healthy and apices vital.

Class II. Sound teeth—pulps diseased by pyorrhea—the pulps having become involved by lymphocytic infiltration.

Class III. Abraded or eroded teeth. Here the abrasion may expose the pulp to direct infection.

Class IV. Average teeth with pulps diseased by trauma, senility or surgical exposure.

Class V. Carious teeth, pulps infected. Apices are yet vital, the symptoms being all pulpal.

Class VI. Infected teeth, septic pulps, canals filled or unfilled—all periapical and not pulpal symptoms. This includes, of course, the most dangerous teeth with the chronic or acute alveolar abscesses, much granulation tissue and necrotic apices.

I would like to touch on a few points as they have a distinct bearing upon the origin and spread of disease from these infected teeth, and to try to show how the infection reaches the blood stream, and I want to refer again to the researches of Noyes and Dewey in the clear demonstration of the wonderful lymphatic network that surrounds the teeth and makes the definite path from the gingival surface of the tooth into the blood stream.

This work was made more decisive by the work of Hartzell, who showed in a study of one hundred apparently sound but pyorrheal teeth that forty-eight per cent of the vital pulps showed invasion by lymphocytes with much destruction and the streptococci definitely determined in the tissue.

Hence the questions of the method of secondary invasion by bacteria from pyorrheal teeth seems to be made a little clearer and the indications for removal of teeth badly involved by pyorrhea made more definite.

Under Class III would probably be placed those wonderful gold helmets that one can see covering many teeth that were crowned about ten to twelve years ago and which should go the same way as so many other crowns in these days. They may not cover a bad tooth but they seem to have produced so much gingival irritation with infection leading down through our wonderful lymphatic nest to the apices with resultant apical localization and then on through the blood stream to the final home.

It was shown by Grieves that only seven per cent of root-canals are completely filled to the apices and that fifty-three per cent of these are apically dis-

eased. Good root fillings are defined by Black as those appearing well into the apex with no open canal beyond. A bad root-canal filling is one that does not reach the apex, projecting beyond it, or leaving an open canal beyond the root-canal filling material.

If fifty per cent of root-canal fillings do not show any apical infection accompanying them there seems to be some reason for trying to save the teeth if the root-canals can be well filled early. But one must consider the question whether the patient's resistance may not be accountable for the large number of undiseased apices. If this should break down the infection would probably go on and involve the apices.

I wish to quote one of our own oral surgeons, Dr. Logan, who in a paper read before the Illinois Dental Association in 1920 recommends as follows:

(1) There is not yet evidence enough to warrant discontinuance of the practice of filling root-canals in teeth that have a normal supporting tissue if the size of the root-canal favors filling it to the apex—if done in an aseptic manner—unless the patient is suffering from an acute infection that might be influenced by even a temporary infection if it should occur at the root of the tooth.

(2) Until the advocates of filling all root-canals can present evidence of being able to permanently control the infection beyond the treated root, one is not warranted in filling canals about which there exists a chronic periapical infection that has resulted in the destruction of the pericemental fibers.

(3) In cases suffering from myo- or endo-carditis, marked hypo- or hyper-blood pressure, neuritis, iritis, chronic nephritis, gastric or duodenal ulcers, I would advise the extraction of all pulpless teeth held to be positively involved with chronic periapical infection.

(4) In cases which present definite radiographic evidence of absorption around the apices, that in the best judgment may have existed for many years and there is no evidence of systemic disease, the danger must be recognized from their presence and these teeth removed as a possible source of future trouble.

The X-ray in Determining the Presence of Infection

No one knows where the weak points of his automobile lie better than the man who runs it, and so no one knows the deficiencies of the x-ray better than the man who has learned to handle it and who can read the language. He must also be better able to show what the x-ray is capable of doing.

One must remember that the x-ray film is made up of shadows of tissues of varying densities and that all it can show is this variation in density. The human mind must interpret these varying shadows. The x-ray will not diagnose disease in teeth. It will show where liquefaction and destruction of bone has occurred and unless such damage has occurred it can show nothing. But on the other hand it is so reliable when it does show absorption that one can be sure that bone destruction has occurred and by reasoning out the matter come to the proper conclusion as to the causes. It can be relied upon in both normal and abnormal tissues. No better diagnostic aid has been produced in determining apical absorption.

Where the radiogram shows a tooth with incompletely filled root-canals with evidence of apical absorption, with destruction of the surrounding tissues, and in the presence of systemic disease, there can be but one answer to the findings of the x-ray,—take out the tooth—with or without curettement as your judgment dictates. In cases of pulpless teeth with well filled root-canals, but not beyond the apex, with no appearance of absorption of the bony bed, it should be allowed to remain *under observation.*

We must remember that no x-ray film

can determine the toxicity or amount of danger from the amount of bone destruction as Grieves has said so picturesquely: "From an entire pyorrheal denture undermined and swaying in purulence, to a single locked periapical area walled off by condensing osteitis or sclerosis, is a far cry in pathology and yet we know the former may do less systemic harm than the latter; just as the hypertrophic pus tonsil may not be a focal factor, while the apparently normal tonsil with its virulent crypt may be most active."

I should like to make an appeal for clean, definite x-ray work in connection with dental work. Personally I think that good dental x-ray results are as hard to obtain as any in the entire body. The areas rayed are small and highly opaque, the patient is many times hard to control and the work is too often turned over to incompetent technicians. There is a noticeable tendency among many dentists to undervalue x-ray films in diagnosing infection and root-canal filling, but I must confess I cannot see how their eagle eyes or sense of touch can be so highly trained as to be able to know what lies down in the depths around the apex of a tooth. If they can they have more sense of diagnosis than I ever hope to have. I sometimes wonder if the real motive is an inability to read and use x-ray data or whether it is to impress one with their great skill. I cannot always bring myself to believe it is not one or other of these. Frankly, I think the best dental radiologist should be a dentist—one who knows things from the clinical side, just as I believe a medical radiologist is best one who has a large clinical medical knowledge. It surely is true when interpretations are in order. Above all he must be willing to show a helpful spirit in his attitude toward either dentist or physician.

I wish to emphasize the dangers and errors in the use of the white blood count in considering the dental infection. It is absolutely unreliable in these cases. We must remember there are many factors here governing the white count. If the abscess be walled off or draining well the white count should be normal. If absorbing as in a closed boil it will react. Also we must remember that we are dealing with a streptococcus infection and that there is a tendency to reduce the white count (a leucopenia), rather than a leucocytosis. I have had occasion to watch many of these cases and I have found that one cannot judge at all by the variation in the *numbers* of white cells.

I want to compliment the dental profession in the attitude it has always taken regarding the school clinics and dental inspection in our own schools. I was on the Board of Education at the time this was first suggested and I know how ready your response was and how you have lent your aid to the work. This public work may not always seem to be fully appreciated, but down in our own hearts and souls we know what it means to the next generation. I feel that a closer co-operation with the Children's Medical Clinic should be established and a helpful attitude assumed by both for the better care of the children and a greater care of the teeth impressed upon the child at the time when greatest danger to the teeth and secondarily to the general health occurs.

Examination of the mouths of the school children in certain areas of Chicago showed ninety-eight per cent had diseased teeth. In some the destruction of the masticating surfaces had been so great as to really hinder the digestion, and in large numbers of cases there was pus discharging from one part of the mouth to the other.

I should like to hear someone here discuss the "dental hygienists" as to their success, for I feel that the busy dentist cannot give his time to clinical work to an extent commensu-

rate to the demand. In some of the large cities, expensive dental dispensaries have been established, as the Forsyth Dental Infirmary in Boston, and similar ones in other cities, and I feel that this is one of the biggest things that the dental profession could father for the children of the country.

Summary

(1) There has been established a definite relation between certain systemic diseases and foci of infection that may be considered primary, located in tonsils, teeth, gall-bladder, intestines and various less important areas.

(2) That cure of the systemic disease is impossible so long as the primary focus continues to pour into the lymphatics and thence into the blood stream fresh supplies of pathologic bacteria.

(3) That dental foci form a very important part of these primary areas and that closer co-operation should be encouraged between the dentist, radiologist and physician in the proper detection of these areas and their proper removal as sources of danger, and that only when all of these come together on common ground will the patient be receiving his proper care.

(4) That not all teeth are infected and that clear judgment must be used in determining just what teeth shall be removed. That a classification of the teeth shows; (1) sound teeth; (2) teeth apparently sound but being surrounded by pyorrheal conditions show infected pulps—infection having come in through the lymphatic system of Noyes—there being no evidence of apical abscess; (3) teeth with infected pulps and apical abscesses. That those of No. 1 are safe; that those of No. 2 can be made safe by proper root-canal filling and kept under observation; that those of No. 3 should be removed as an actual or at any rate potent factor of danger.

(5) That three factors control the dangers of focal infection. (1) The immunity of the patient; (2) the lowered resistance due to some intercurrent condition; (3) the virulence of the infection; and that for these reasons great care should be exercised in not removing too many teeth at one time because of the great amount of new absorbing surface produced and the inability to judge of the virulence of the infecting bacteria.

(6) That if the x-ray is not asked to give more than its nature will allow it to do it will form the best single diagnostic agent we have and should be used liberally rather than sparingly.

(7) That it is the duty of organized dentistry and medicine to secure for children proper facilities for learning to care for their teeth, and teaching the methods of prevention of decay and infection, and that the public must be clearly informed as regards the production of systemic diseases.

(8) That until oral pathology is placed upon the firm and definite footing by those working constantly with the teeth and their surrounding tissues that no definite progress can be made in the prevention of focal infection so far as the oral cavity is concerned.

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THE RELATION BETWEEN MECHANICAL AND ANATOMICAL ARTICULATION

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(Read before the Los Angeles County Dental Society, October 24, 1922; Boston Prosthetic Club, February 8, 1923; First District Dental Society, Prosthetic Section, Special Meeting, February 19, 1923)

THE problems of denture construction, with which you are daily confronted, are so diversified, that a simple standard or universal formula, for their solution should be considered beyond reasonable expectations.

Failures, which we from time to time experience with our accomplishments, remind us that "man thinking" has his limitations. All human achievements have passed from failures through thinking into applied craft, art and science. Let us give thought to one problem of the many we have.

The basis of our conception of articulation is the articulation of natural teeth. Articulation is the change from one occlusal position to another, while the masticatory surfaces maintain contact. I suggest consideration of the following main occlusions as applying to the masticatory surfaces or to the maxillomandibular relation: Central occlusion; protrusive occlusion, right lateral occlusion, left lateral occlusion, intrusive occlusion.

You will note that I do not especially mention retrusive occlusion which, according to my interpretation, is normally but an intrusive occlusion of the mandible to the posterior. In some dentures a pronounced retrusive movement is used during the masticating strokes. This seems to me an abnormal condition.

Central Occlusion

The masticatory surfaces are in central occlusion when the cusps of the upper interdigitate buccally between the corresponding lower cusp and its distal neighbor; the upper and lower incisors are symmetrically arranged in two nearly concentric arcs between the cuspids and are in more or less intimate contact.

The mandible is in central occlusion when the condyle heads rest gently in their sockets and the teeth are in contact.

Protrusive Occlusion

The masticatory surfaces are in protrusion, when the lower teeth are in contact with the upper, anteriorly to central occlusal relation. The mandible is in protrusive occlusion, when both condyle heads have made excursions forwardly and downwardly in their fossae.

Right Lateral Occlusion

The masticatory surfaces are in right lateral occlusion, when the lower teeth are in contact with the upper teeth in a position laterally to the right of central occlusion. The mandible is in right lateral occlusion, when the right condyle head has made an excursion laterally and the left condyle head an excursion forwardly, and usually downwardly and somewhat inwardly.

Left Lateral Occlusion

Left lateral occlusion of the masticatory surfaces as well as of the mandible is a lateral image, or nearly so, of the right lateral occlusion.

Intrusive Occlusion

Intrusive occlusion of both, the masticatory surfaces and the mandible, are occlusions under applied forces, which incur temporary displacement or compression of tissues. The effect of the unroundness of the condyle heads may be neglected within the limits of articulation. Intrusive occlusion is not an independent occlusion; it is always associated with one of main occlusions or an intermediate occlusion.

The above interpretation brings us to the realization that a variance of the magnitude of intrusion will associate a series of occlusal relations of the mandible with one occlusal relation of the masticatory surfaces, and vice versa. This applies to the anatomical masticatory apparatus involving resilient tissues, and not to the articulator mechanism with its constrainedly guided parts and the dentures mounted rigidly therein by plaster of Paris. No intrusive occlusion exists in the articulator. All other occlusions of the masticatory surfaces and of the jaw members are coincident.

Here we have the key to the situation, which, though complicated in itself, is easily mastered, when understood fundamentally.

We distinguish four kinds of articulation:

1. *Anatomical Articulation,* which is articulation governed by at least three pairs of anatomical guiding elements, for example, by the two condyle heads in their fossae and by two opposed guiding surfaces of natural teeth.

2. *Semi-Anatomical Articulation,* which consists of two anatomical guidances at the condylar joints and a third selected guide in the mouth, as is the guidance of artificial teeth upon natural, or of opposed artificial teeth against each other.

3. *Mechanical Articulation,* which is articulation produced in an articulator set and adjusted to compensate for the difference between mechanism and anatomy.

4. *Articulator Articulation,* which is articulation adapted to an arbitrarily chosen mechanism, irrespective of the anatomical requirements.

The search for a satisfactory solution of the problem of what constitutes articulation and of how to establish it in an auxiliary device, known as an articulator, has been very intense during the past few decades. Our dental literature gives ample proof thereof.

Articulation itself is a purely physical function. It therefore should surprise us not, that previous and present investigators accompanied the presentation of their conception of articulation with a mechanism, which incorporates and illustrates their ideas of the subject. I mention the names of Christiensen, Snow, Gysi, Hall, Monson, Needles and Hanau. Scores of names could be added.

Snow, Gysi and their precursors have laid the foundation upon which I base my work. The conical theory of Dr. Hall, the spherical theory of Dr. Monson, and the theory of the concentric spheres by Dr. Needles were the subject of my attacks in discussions and papers read before various professional societies.[1]

The three theories last mentioned (Hall, Monson, Needles) should never have been taken seriously, as they are neither scientific nor logical, in spite of their authors' assertions.

The basic ideas of our present con-

[1]American Institute of Dental Teachers, Indianapolis 1921; National Society of Denture Prosthetists, Milwaukee, 1922, etc.

ception of articulation were very ably presented to us by Drs. Snow's and Gysi's theoretical work and ingenious devices, illustrating their conception of the masticatory operation. The Gysi Simplex device eliminates itself from consideration, as the principles incorporated therein are inconsistent with Dr. Gysi's valuable findings.

In the study of the work of each investigator, including the above named, you will find that the endeavor was made to design an apparatus, which reproduced mandibular movements. Some claimed an exact reproduction of such movement. As a matter of fact, some claimed that their pet mechanism represents that ideal movement, which the Great Creator seemingly had failed to establish or to preserve in the condylar joint of the unfortunate patient. Other authors and inventors were more modest; they accepted, as universally applicable, those standards which previous masters of art—and of speculation—handed down to us. The most naive of our geniuses had intuitions, moulded them in metal, attached a decorative theory unto their accomplishment and,—it must be admitted—they found a goodly number of fanatical believers and blind followers, whose mental inertia probably did not care to penetrate even the polish of the nickel-plated instrument under consideration. They are responsible also, in a large measure, for the existing state of ignorance and impotence.

The natural masticatory apparatus consists of individual teeth, rooted fairly firmly in the jawbones. The jaws themselves join in a sliding hinge, which is provided with two interposing elements, the fibrocartilages. These permit intrusion of the condyle heads into their sockets. The shape of the condyle heads, the shape of the cartilages and their resiliency is responsible for intrusion. The effect upon the relative position of mandible to maxilla, whatever the cause may be, is the same. We shall refer to the resiliency only in the following, yet keep in mind that the aforesaid contributory causes exist.

Artificial full dentures are associated with four resilient elements, interposed between the parts which comprise the restored masticatory apparatus. At each of the condylar joints and below each plate we have an interposition of resilient tissues through which co-active forces are transmitted during the execution of physical mastication.

We shall first dwell upon the conditions pertaining to full dentures, for they present all the features found in natural normal dentures, traumatic dentitions, partial dentures and edentulous masticating apparatus. Lastly we shall consider the latter four by elimination of elements.

The masticatory apparatus, equipped with a full denture, is comparable to a power and working machine. The power is generated by co-ordination of a complex arrangement of simultaneously and alternately operating muscles and ligaments. That the elements comprising the power mechanism are interesting and important for many reasons, I need not point out, yet their consideration is not necessary for our analysis, provided we are right in our conception of their effect upon the working mechanism.

Let me illustrate my seemingly audacious contention by an example: The lathe is a working machine, invariably hitched to, relayed with, or combined with a power mechanism. A description or and analysis of the mechanism lathe may, without detriment to succinctness, start with the framework and wind-up with the spindle, rotated by motive power. Similarly we may apply the logic: The working mechanism of the restored masti-

catory apparatus is made up of the following co-acting main elements:

1, The upper plate; 2, The tissues between upper plate and the maxilla; 3, The maxilla, consisting of an assembly of rigidly joined bones; 4, the fibrocartilages, interposed in separated places between maxilla and mandible; 5, The mandible—a single bone; 6, The tissues between mandible and lower plate; 7, The lower plate.

That part of the working cycle of mastication, which is of prime importance to prosthodontists, obtains the moment the chain of elements becomes closed either by direct contact of the upper and lower denture, or by an interposed bolus of food. Of further importance is the relation of the elements for an open chain, during relaxation, speech and apprehension. In either case forces act between the elements and, of course, through them. The magnitude of these forces range from the negative to the positive, or, we may say, forces may act to separate two elements or hold them together.

I have frequently been assailed for making too many assumptions. I pray, you accept the following: It may be assumed throughout, that all elements, except the food, will withstand the applied forces without immediate destruction, and also, that the anatomical elements are securely linked without danger of their sudden collapse or dismemberment. If my assumptions be accepted, then it remains, that the effective operation of restored dentures is largely dependent upon the permanency of retention of the substituted elements to the complemented anatomical elements.

I attribute our numerous difficulties in denture construction to the failures to comply with the two principal and reciprocal requirements: 1, Establishment of occlusions; and 2, Establishment of retention.

Occlusions and impressions are not a fifty-fifty proposition, if my observations are correct. The share belonging to each factor cannot be expressed in mathematical terms. It varies in each case and is indeterminable in all cases—two good reasons why we should endeavor to obtain perfection for both.

I venture to state that perfect occlusions contribute more effectively to permanent stability than perfect impression work, yet I do not wish to infer that perfect impressions are to be looked upon indifferently. It is well known that the best impression work will not maintain stability when associated with defective occlusions, and it is also conceded that the establishment of balanced occlusions will not only be of assistance in maintaining stability, but also is a stimulant to physiological changes which improve adaptation, and so assist in maintaining stability. On the other hand, it is evident, from clinical experience, that the best possible impression does not maintain stability, when associated with faulty, unbalanced occlusions. The many cases which require rebuilding on account of defective occlusions amply justify my contention.

I stated my interpretation of articulation in previous papers and shall repeat only that part which bears directly upon the subject.

Natural articulation in its entirety is not suitable for reproduction in artificial dentures. The latter require balanced occlusions through the entire stroke of applied articulation. Balanced occlusions infer a contact relation of the masticatory surfaces. Two or more contact points at each posterior end of the arch and one (or more) in the anterior region of the denture constitute a favorable pressure distribution.

I am using the customary expressions, three point contact and multiple point point contact; in fact, each point spoken

of represents a fragmental surface of contact, or closely spaced independent surface fragments of adjacent cusp inclines. I frequently spoke of contact areas and of the intimacy of contact in these areas. You are referred to "Dental Engineering," which is available in mimeographed form.

Balanced central occlusion, according to my view, is not an evenly intimate contact relation along the entire masticatory surfaces. I accept that a perfectly satisfactory central occlusion for dentures under applied muscular forces has

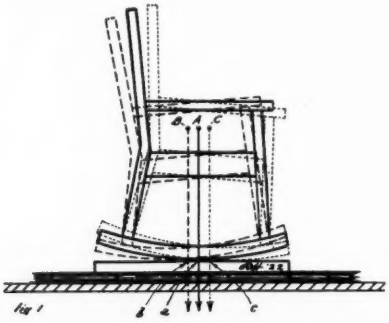


Fig. 1.—The rocking chair with a base, illustrating the occupant's center of gravity in positions A, B, C and transmitted to the base at points a, b and c.

a greater intimacy of contact on the left and the right side about the first molars; to the posterior and to the anterior a gradual decrease of intimacy of contact occurs, and it winds up in total loss of contact at the anterior or the posterior or at both regions. This means that spaces between various regions of the opposed masticatory surfaces exist for different applied forces.

I compare such arrangement with a type of rocking-chair, one having a base below the rocker. (Fig. 1.) One purpose of such a rocking-chair design is evident. Grandfather's weight, which acts in the center line at "a" upon the base, is favorably transmitted to grandmother's carpet. The weight is evenly distributed over a greater area, and in consequence, exerts less pressure per unit area. When grandfather's center of gravity shifts from "A" to "B", then his weight is transmitted at "b" to the base. Point "b"

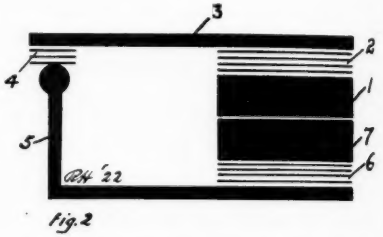


Fig. 2.

Fig. 2.—Schematical side elevation of the anatomical masticatory apparatus equipped with artificial dentures in central occlusal relation, under an accepted pressure, with contact all along the masticatory surfaces. It represents: 1, the upper denture; 2, the tissues between upper denture and maxilla; 3, the maxilla; 4, the condylar tissues; 5, the mandible; 6, the tissues between mandible and lower denture; 7, the lower denture.

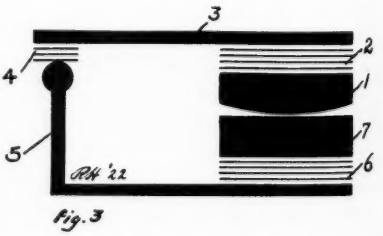


Fig. 3.

Fig. 3.—The anatomical apparatus provided with a rocking fit of the masticatory surfaces in central occlusion. All other items as in Figure 2.

is some off the center "a". In consequence the back part of the base will transmit a greater share of the applied weight to the carpet. The weight is less favorably distributed; it becomes somewhat greater per unit area at the back.

A similar condition, that of distribu-

ting the pressure, is produced by a bolus of food between two dentures backed by resilient tissues, and also when the dentures are in contact under muscular tension.

A rocking-chair fit of the masticatory surfaces (pardon the simile) serves a double purpose. It secures favorable pressure distribution in central occlusions under loads and it prevents interference of the masticatory surfaces which is invited by dentures slightly lifted by relieved resilient tissues; in lateral and protrusive occlusions when initiating articulation of the surfaces, forces may or may not act. In either case, the masticatory surface formation, as described, presents advantages. Figures 1 to 15, of which I shall give a brief description, will more clearly illustrate my views.

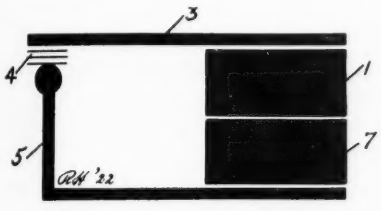


fig. 4

Fig. 4.—The anatomical masticatory apparatus with natural dentures; the resiliency between teeth and mandible, or maxilla respectively, is negligible. Contact along the entire masticatory surfaces.

fig.5

Fig. 5.—Same as Figure 4 except that a rocking fit is shown.

The masticatory apparatus will be represented schematically. The different elements referred to above are indicated by numerals.

Figure 2 shows the masticatory apparatus equipped with artificial dentures 1 and 7, which rest upon the resilient tissues 2 and 6 respectively; 3 and 5 represent the maxilla and the mandible. Between these the resilient fibrocartilage element is interposed. It will be noted that elements 1 and 7 fit upon each other, that is to say, they are in contact along the entire masticatory surfaces. Figure 2 schematically illustrates the conception of occluding surfaces, which was given to us by Angle.

Figure 3 also represents the mastica-

fig. 6

Fig. 6.—The mechanical apparatus (articulator) with dentures mounted rigidly with plaster of Paris to the jaw members and a constrained condyloid guidance. No resilient elements are present.

fig. 7

Fig. 7.—Same as Figure 6 except that a rocking fit is shown.

tory apparatus equipped with plates. It will be noted that the masticatory surfaces do not maintain the same intimacy of contact from the anterior to the posterior. The rocking fit, as was said before, applies to central occlusion particularly. The characteristics of the

Fig. 8

Fig. 8.—Schematical illustration of the effect caused by tissues lifting the dentures in the anterior region, when initiating the masticatory stroke at a moment, when no or little pressure is exerted. The danger of tipping the dentures is evident.

rocking fit are gradually lost towards protrusive and lateral occlusion and it disappears entirely near their extremes.

Figure 4 represents the natural masticatory apparatus showing an occlusal

Fig. 9

Fig. 9.—Same pressure conditions as in Figure 8. The rocking fit throws the contact towards the center, thus enhancing stability and securing more even pressure distribution.

contact from the anterior to the posterior, and in Figure 5 we have the provision of a rocking fit. There is no necessity for the natural denture to have a very pronounced rocking fit, because the only resilient link in the chain of elements is the fibrocartilage. The effect of resiliency of the fibrocartilage is greatly reduced by the leverage. An intrusion occurring at the fibrocartilage is reduced from three

Fig. 10

Fig. 10.—Same as Figure 8 except that premature contact is introduced in the posterior region.

to ten times its original magnitude, when considered at the masticatory surfaces.

Figures 6 and 7 represent plates in an articulator. The number of elements is reduced to four due to the fact that a resilient member does not exist in the mechanism and also because the plates

Fig. 11

Fig. 11.—Same as Figure 9 except that contact is initiated in the posterior region.

are attached rigidly to the maxillary and mandibular jaw members of the articulator.

It is of particular importance to the prosthodontist to *note the difference that exists between the denture in the mouth*

and the denture in the articulator. Very complicated statical and cinematical considerations enter into the problem of making measurements in the mouth upon resilient tissues with rims, of building a denture in the articulator which is con-

Fig. 12.

Fig. 12.—The upper is lifted in the anterior region and the lower in the posterior region; in consequence the dentures are displaced horizontally in opposite directions, aside from being displaced vertically. The figure shows anterioposterior displacement, analogous conditions may cause lateral displacement.

strainedly guided and of providing smooth working of the complicated masticatory surfaces in the resilient mouth from which measurements were originally

Fig. 13.

Fig. 13.—The rocking fit for conditions described in Figure 12. It will be noted that the rocking fit alone cannot fully remedy the defect. Relief of the seating surfaces of the dentures above the resilient tissues and surgical treatment should be considered.

taken. To my knowledge no consideration has been given to this important factor by previous investigators and builders of articulators.

Without entering into theoretical detail, the following figures are given as representing conditions which are introduced by the resiliency of tissues upon which the plates rest.

Figures 8 and 9 show plates of which

Fig. 14.

Fig. 14.—Conditions are reversed to those illustrated in Figure 12.

it is accepted that they are transferred from the mouth to the articulator in a positional relation under muscular forces. Under such conditions it must be accepted that the resilient tissues were compressed or displaced by pressure. Then they were mounted in the articulator, set

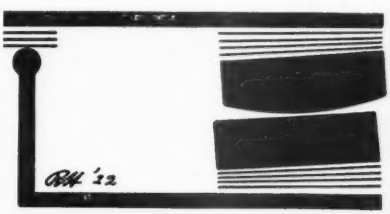


Fig. 15.

Fig. 15.—Conditions reversed to those shown in Figure 13.

up, and ground in, to articulate in said relation, and, lastly, when transferred back to the mouth, it must be expected, that a maximum of displacement will occur at those regions where a maximum of resiliency in the anterior portions of both the upper and lower prevails.

Figures 10 and 11 illustrate a greater resiliency in the posterior portions of upper and lower. Figures 8 and 10 illustrate the effect upon the masticatory surfaces which were ground-in, in accordance with accepted practice, while Figure 9 and 11 show the effect of the same conditions upon dentures which have a rocking fit of the opposed masticatory surfaces. The effect is greatly exaggerated in all figures, solely for the purpose of illustration. It is evident from Figures 8 and 10 that, upon closing of the mouth, those regions which are lifted by the resilient tissue will establish contact of the masticatory surfaces before the remaining part. The consequence of such premature contact, at one extreme or the other, will introduce the tendency of tipping of the plates, where contact has not been established. It will be noted that the difference of curvature of the masticatory surfaces, which is characteristic of the rocking fit, introduces contact of the surfaces not at the ends, but towards the center. By such means stability is enhanced for the reason that the distribution of pressure below the plates becomes more favorable.

Figures 12, 13, 14 and 15 represent the resulting relation of upper and lower plates by resiliency, which is diagonally distributed below the opposed plates. The consequence of such distribution, which is occasionally met, is very unfavorable to the establishment of stable occlusal relation and of articulation in the end. Invariably we may describe such a malrelation of upper and lower plates in the mouth as missing-the-bite. Such conditions have to be very carefully guarded against, for they invite alterations of tissues, resulting from interference of the cusps. They may be observed in the mouth of the patient when the dentures are brought together slowly and gently, and not when the patient has the masticatory surfaces closed upon each other under muscular tension. In all cases where such a condition is detected, the operator must be careful in the selection of the cusp heights and the resulting curve of Spee.

The disturbances illustrated by Figures 9, 10 and 11 are not as serious as those represented by Figures 12, 13, 14 and 15. In the first cases we have a plain rocking of two surfaces upon each other, while in the other cases a gliding motion accompanies the rocking of the two surfaces upon each other; that means, that in the latter cases forces act, which tend to displace the plates horizontally, and thus impairing the permanency of stability.

CLASSIFICATION OF THE DENTAL SCHOOLS OF THE UNITED STATES

BY THE DENTAL EDUCATIONAL COUNCIL OF AMERICA

JULY 1, 1923

CLASS A

University of Southern California, College of Dentistry, Los Angeles, California.

Chicago College of Dental Surgery, Chicago, Illinois.

Northwestern University Dental School, Chicago, Illinois.

University of Illinois, College of Dentistry, Chicago, Illinois.

State University of Iowa, College of Dentistry, Iowa City, Iowa.

University of Louisville, College of Dentistry, Louisville, Kentucky.

Harvard University Dental School, Boston, Massachusetts.

Tufts College, Dental School, Boston, Massachusetts.

University of Michigan, College of Dental Surgery, Ann Arbor, Michigan.

University of Minnesota, College of Dentistry, Minneapolis, Minnesota.

St. Louis University School of Dentistry, St. Louis, Missouri.

Washington University School of Dentistry, St. Louis, Missouri.

Creighton University, College of Dentistry, Omaha, Nebraska.

University of Buffalo, College of Dentistry, Buffalo, New York.

Western Reserve University Dental School, Cleveland, Ohio.

Thomas W. Evans Museum and Dental Institute, School of Dentistry, University of Pennsylvania, Philadelphia, Pennsylvania.

University of Pittsburgh, School of Dentistry, Pittsburgh, Pennsylvania.

Vanderbilt University, School of Dentistry, Nashville, Tennessee.

Baylor University, College of Dentistry, Dallas, Texas.

Marquette University, College of Dentistry, Milwaukee, Wisconsin.

CLASS B

University of Denver, School of Dentistry, Denver, Colorado.
(Formerly Colorado College of Dental Surgery)

Georgetown University, Dental Department, Washington, District of Columbia.

Howard University Dental College, Washington, District of Columbia.

Atlanta-Southern Dental College, Atlanta, Georgia.

Loyola University, School of Dentistry, New Orleans, Louisiana.

Tulane University of Louisiana, School of Dentistry, New Orleans, Louisiana.

University of Maryland, School of Dentistry, Baltimore, Maryland.
(Baltimore College of Dental Surgery was merged with it on June 15, 1923)

Kansas City-Western Dental College, Kansas City, Missouri.

University of Nebraska, College of Dentistry, Lincoln, Nebraska.

Ohio State University, College of Dentistry, Columbus, Ohio.

North Pacific College of Dentistry, Portland, Oregon.

Temple University Dental School, Philadelphia, Pennsylvania.
(Formerly Philadelphia Dental College)

Meharry Dental College, Nashville, Tennessee.

University of Tennessee, College of Dentistry, Memphis, Tennessee.

Medical College of Virginia, School of Dentistry, Richmond, Virginia.

CLASS C

Cincinnati College of Dental Surgery, Cincinnati, Ohio.

Texas Dental College, Houston, Texas.

CLASSIFICATION POSTPONED

University of California, Dental Department, San Francisco, California.

(Classification postponed until September 15, 1923)

College of Physicians and Surgeons of San Francisco, San Francisco, California.

(Classification postponed until September 15, 1923)

Indiana Dental College, Indianapolis, Indiana.

(Classification postponed until September 15, 1923)

Columbia University School of Dentistry, New York, New York.

(Incorporation of the College of Dental and Oral Surgery of New York, and reorganization of the united schools, in progress)

New York College of Dentistry, New York, New York.

(Merger with New York University in process of negotiation)

Ohio College of Dental Surgery, Cincinnati, Ohio.

(Affiliated with the University of Cincinnati on July 1, 1923; early complete merger in prospect)

MERGED RECENTLY WITH UNIVERSITIES

Colorado College of Dental Surgery.

(Merged with Denver University, June 15, 1922)

Baltimore College of Dental Surgery, Baltimore, Maryland.

(Merged with the Dental Department of the University of Maryland, June 15, 1923)

College of Dental and Oral Surgery of New York, New York City.

(United with the School of Dentistry of Columbia University on July 1, 1923)

DISCONTINUED SINCE THE PUBLICATION OF THE LAST PREVIOUS CLASSIFICATION IN 1920

(1921) George Washington University, Dental School, Washington, District of Columbia.

(1923) University of West Tennessee, Dental Department, Memphis, Tennessee.

OFFICERS

President: Thomas J. Barrett, 507 Main Street, Worcester, Massachusetts.

Vice-President: Marcus L. Ward, 1308 Cambridge Road, Ann Arbor, Michigan.

Secretary-Treasurer: Albert L. Midgley, 315 Butler Exchange, Providence, Rhode Island.

John H. Baldwin, 540 Atherton Building, Louisville, Kentucky.

Henry L. Banzhaf, 140 Sixteenth Street, Milwaukee, Wisconsin.

Charles M. Benbrook, 707 Auditorium Building, Los Angeles, California.

Thomas W. Broadbent, 25 E. Washington Street, Chicago, Illinois.

William T. Chambers, 504 California Building, Denver, Colorado.

John V. Conzett, 116 West Thirteenth Street, Dubuque, Iowa.

Augustus R. Cooke, 815 University Building, Syracuse, New York.

Sheppard W. Foster, 100 No. Butler Street, Atlanta, Georgia.

H. Edmund Friesell, 1206 Highland Building, Pittsburgh, Pennsylvania.

Clarence J. Grieves, 201 West Madison Street, Baltimore, Maryland.

Arthur E. Hackett, 209 Post Street, San Francisco, California.

William E. Hocking, Devil's Lake, North Dakota.

Louis Meisburger, 85 N. Pearl Street, Buffalo, New York.

Clinton A. Nixon, 9 Main Street, Valparaiso, Indiana.

Forrest H. Orton, 1229 Lowry Building, St. Paul, Minnesota.

Alfred Owre, 2109 Blaisdell Street, Minneapolis, Minnesota.

Alexander H. Reynolds, 4630 Chester Avenue, Philadelphia, Pennsylvania.

Charles R. Turner, 40th and Spruce Streets, Philadelphia, Pennsylvania.

C. Victor Vignes, 830 Canal Street, New Orleans, Louisiana.

Frederick C. Waite, 1353 E. Ninth Street, Cleveland, Ohio.

Herbert L. Wheeler, 560 Fifth Avenue, New York, New York.

Editorial Department

MEMBERSHIP IN THE AMERICAN DENTAL ASSOCIATION

There seems to be among many of our members an inadequate conception as to the significance of their membership in the American Dental Association. With our present plan of organization every individual who is a member in good standing of any branch of any state society which is a component of the American Dental Association is by virtue of that fact an integral part of the parent organization. This should be recognized in its full significance, and when it is will give the member a more vitalized conception of his relationship to the Association, and point the way to a keener interest in its welfare.

Too many men accept the fact of their membership in an incidental way—considering only the benefits to be derived from membership and taking no account of their obligations in the matter. It is the same position that is frequently assumed by men in a community so far as their relation to government is concerned. They "lay the flattering unction to their soul" that they have to do only with the municipality in which they live, or possibly with the county, or possibly with the state. That is the utmost limit of their vision. It never seems to enter their heads that above and beyond all of this there is a great comprehensive central governing body known as the Federal Government, of which they are as much a part as they are of the smallest municipality. The Federal Government functions for the humblest citizen of the Commonwealth just as it does for the President; and the American Dental Association functions for the quiet member of the component society located in the far-flung districts on the outskirts of civilization the same as for the officers and trustees. Many men are so absorbed in the local society that they look upon it as the summum bonum. True it is that the local society furnishes the most frequent opportunities for personal contact with fellow-members, and in this regard it is of the greatest and most constant value; but organized dentistry never would have assumed the importance it has in the eyes of the world without the parent body—our great national organization.

Our members should take pride in the fact that they belong to one of the greatest dental organizations in the world, and it should be a matter of loyalty and of love with them to further its interests in every

conceivable way. Each individual can help in some manner—not only in the payment of dues promptly, but in the moral support which after all becomes a real asset to any organization. The thing to remember is that in their dental society relationships they should not fail to keep constantly in mind the significant fact that membership in a component branch constitutes a vital connection with the main body, and that they are in very truth and fact an essential unit in the splendid organization known as The American Dental Association.

BORN OF THE PROFESSIONAL SPIRIT

The ideals and ambitions of the truly professional man can be summed up in the one word—*Service.* If he is a member of the healing profession, his whole mentality will be engrossed in the all-absorbing problem of giving relief to suffering humanity. To such men the financial recompense becomes a secondary consideration. The life story of the really great men in medicine and dentistry, from the time of Hippocrates down, goes to prove the truth of this statement. They have willingly given of their years and their skill, that some of the vital problems relating to disease and health might be brought nearer a solution.

Compare, if you will, the careers and services of such men with the keen "practical" business man whose whole energy is concentrated on the one problem of building up a prosperous and lucrative enterprise.

Between these two classes, as one can readily see, "there is a great gulf fixed." The hard-headed man of affairs cannot successfully cross this gulf unless he "be born again"—born of the professional spirit.

The great need in dental practice today is not that we should develop a keener business mentality, or to aim generally at a higher standard of fees (though the latter may be true in many instances), but rather that the profession should sternly set its face against the threatened inroads of the mercenary spirit in the ranks of our profession.—*Oral Health,* February, 1923.

IN MEMORIAM

Burton Lee Thorpe, M.D., D.D.S.

Burton Lee Thorpe, died July 9, 1923. The funeral services were held at Elmwood Chapel, Kansas City, Missouri, on July 10, 1923.

Burton Lee Thorpe, M.D., D.D.S., was born June 29, 1871, Belmond, Iowa. He was educated in the public schools and began the study of dentistry with a preceptor in 1890. He attended the Kansas City-Western Dental College, Kansas City, Missouri, and graduated with the degree of D.D.S., March 5, 1895. Immediately after becoming a member of the Missouri State Dental Association he

served the society as Corresponding Secretary 1898-99 and 1900, and was elected its President 1901. The same year he was appointed by Governor A. M. Dockery member of the Missouri State Board of Dental Examiners and in 1903 reappointed for five years, serving as President of the Board in 1903. He was elected vice-president for the west of the National Association of Dental Examiners 1901 and 1902 and in 1903 was elected president, but resigned, August 1903, when, assisted by Drs. D. O. M. LeCron and S. T. Bassett, he organized the Barnes Dental College of which he was the first dean of the Faculty, and Professor of Operative Dentistry and Dental History. Owing to a disagreement with the trustees, he, with the entire faculty, resigned December 1905, after two and a half years' service. Dr. Thorpe was the originator of the Fourth International Dental Congress held at St. Louis 1904. In 1900 he took the initiative and presented the plan of organization to the Missouri State Dental Association and the National Dental Association. He was appointed by the latter society as one of the Committee of fifteen to organize the congress, and did yeoman's work in assisting making the congress the great success it was. The Universal Exposition Company conferred a commemorative diploma and gold medal on him for the important service he rendered in this connection. In 1904 he became associate editor of "The Dental Brief" a position he retained until publication was discontinued. In 1904 he was elected assistant secretary for five years of the Federation Dentaire Internationale and one of a committee of five delegates to the same, representing the National Dental Association of the United States to assist in organizing the Fifth International Dental Congress at Berlin, August 23 to 28, 1909; was the originator of the Jamestown Dental Convention held at Norfolk, Virginia, September 10 to 12, 1907 and a member and chairman of its Committee on Organization. He was corresponding secretary of the National Dental Association 1906, 1907 and 1908 and secretary of the Committee on History of the same; also secretary of the International Dental Federation, Commission on History, chairman committee on History of the Missouri State Dental Association, chairman committee on History, St. Louis Society of Dental Science, and member of the St. Louis Medical History Club and the Fourth International Dental Congress Committee on History; president of the St. Louis Society of Dental Science 1905; organizer and first president of the St. Louis Auxiliary Supreme Chapter Delta Sigma Delta Fraternity; member of the National Dental Association, American Medical Association, Missouri State Dental Association, St. Louis Society Dental Science, St. Louis Dental Society; honorary member of the Kansas, Colorado, Virginia, Ohio, Iowa, Southern Illinois Dental Societies, Delta Sigma Delta and Interstate Dental Fraternities and the Dental Society of South Wales. In 1904 he received the degree of M. D. from the Barnes University. On December 4, 1895 he married Miss Berta Scott.

From his entrance into dentistry he became interested in the profession's history and spent his odd moments in collecting historical data, photographs and relics of the past. In 1902 he began a series of biographical sketches on the pioneers of American dentistry published monthly in "The Dental Review," appearing until 1904, then monthly until 1909 in "The Dental Brief." He is author of volume on "The Founders and Ex-Presidents of the Missouri State Dental Association. The highest honor in the gift of the dental profession was conferred on Dr. Thorpe at Birmingham, Alabama March 31, 1909 when he was unanimously elected president of the National Dental Association. Dr. Thorpe was elected Supreme Grand Master Delta Sigma in 1914 and presided at the meeting in San Francisco in 1915. He was a thirty-second degree Mason and a Shriner. Was also a member of the Sons of the American Revolution and Son of Colonial Wars.

Medical and Dental News

CALIFORNIA

The Osteopaths Win in California: In California the osteopaths have won a fight to secure appointments to positions in county hospitals. This means that not only osteopathic physicians may be on the staff of a county hospital, but that the interns may be osteopaths. The next thing in order is to place chiropractors and Christian Scientists on the staffs of county hospitals.—Journal of the Indiana Medical Association, April 15, 1923.

What Los Angeles Thinks of the Abrams Cult: In the Bulletin of the Los Angeles County Medical Association, published April 5, 1923, there appeared this item:

The following resolution was adopted at the meeting of the Board of Councilors held March 12, 1923: "It shall be the sense of the Council that Abrams' method of diagnosis is a fraud. Any physician practicing this method is ineligible to membership. If a member, he shall immediately cease this method of practice or charges of unethical conduct shall be preferred against him."

If more medical societies would take this action, the activities of those now exploiting the Abrams nonsense—diagnosing syphilis in healthy persons and professing to cure cancer by means of the "Oscilloclast"—would be confined to those "drugless healers" and "advertising specialists" who already form so large a part of Abrams' disciples.—Journal American Medical Association, April 28, 1923.

Notice to Dental Hygienists: The Program Committee is making arrangements for an unusual program of interest to be given during the State Dental Hygienists' meeting which will be held concurrently with the California State Dental Association. Persons interested in obtaining information regarding the program, and who wish to make reservations for the Round Table Luncheons, should communicate immediately with Miss Anita C. Junck, 3696 17th Street, San Francisco.—The Dental Hygiene News Letter, May, 1923.

CONNECTICUT

Dental Hygiene in Bridgeport Schools: Since June, 1921, Bridgeport has enforced a physical education program which requires several health standards for promotion and as one of these dental requirements has been applied as a passing requisite from grade 5 to grade 6, since the major part of the dental hygiene work is done in the first five grades. The promotional requirement has been (1) a clean mouth, (2) a satisfactory demonstration of home care of the mouth, and (3) no unfilled cavities in the permanent teeth. Last fall practically 100 per cent of the children passed from grade 5 to grade 6 with sound permanent teeth and clean mouths.

The Bridgeport school records indicate that the condition of a child's teeth has much to do with his progress in school. Bridgeport now spends less than any other city of its size for the schooling of children who are compelled to repeat their grades.—Philadelphia North American, May 17, 1923.

LOUISIANA

Portable Motion-Picture Outfits are to be provided by the United States Public Health Service, the Rockefeller Foundation, and other similar organizations for the use of parish health units in their campaign for the eradication of the mosquito, fly, and hookworm. A special department will be inaugurated by the State Board to provide films for this purpose.—Journal American Medical Association, Chicago, May 26, 1923.

MASSACHUSETTS

Gift for Cancer Research: The Hancock Life Insurance Company, Boston, has made an additional gift of $20,000 to the Harvard Cancer Commission; $5,000 to be used for purchase and installation of a diagnostic apparatus and $15,000 to be placed in the permanent fund. The insurance company previously gave $30,000 toward the building of the Huntington Hospital, which is devoted exclusively to cancer cases. The new gift will be used in the biophysical laboratory, which is also under the direction of the commission.—Journal American Medical Association, June 9, 1923.

MICHIGAN

Chiropractor Fined: It is reported that Ward F. Miller, chiropractor, of Shepherd, was recently found guilty of violation of the state medical registration law and was sentenced to forty-five days in the county jail and fined $150.—Journal American Medical Association, June 2, 1923.

MINNESOTA

"Owning Their Own Milk Supply": By Charles W. Holman. An account of the co-operative milk-distributing service organized in 1919 by workers in the milk industry and milk consumers in Minneapolis. The association is now selling more than one-fourth of all the milk used in the city. Private dealers and the co-operative association sell their milk at the same price, but patrons of the co-operative association receive a patronage dividend which reduces the cost. The co-operative is being fought by the private dealers who fear an extension of the system.—Woman Citizen, May 19, 1923.

OHIO

A "Save the Babies" Child Welfare Campaign was conducted in Dayton, May 7-12, during which examinations of babies under 2 years of age were held daily. A health bulletin was issued, giving information on prenatal and infant care, which will be mailed free each month on request.—Journal American Medical Association, Chicago, May 19, 1923.

GENERAL

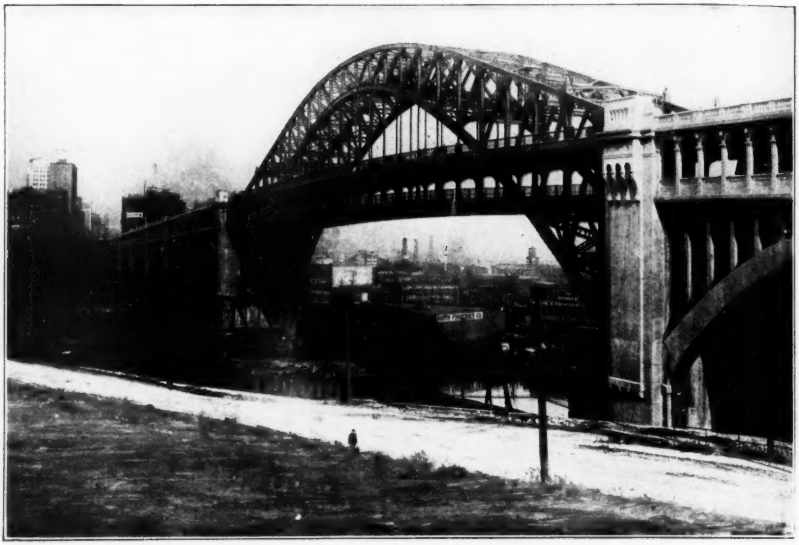
Good Dentistry a Necessity: To try and cure all bodily ailments without the aid of good dentistry is like trying to force the gas out of a room without blocking up the pipe from which it is escaping. In other words, it is no use trying to effect a permanent cure of a disease without first ascertaining and removing the cause. It has been shown time after time that, in innumerable cases, the cause is in the teeth. Why, then, is not more attention paid to the teeth? It is to be hoped that, as time goes on, Governments will realize the fact and place the services of capable dentists at the disposal of the very poor. By so doing they will not only contribute largely to the welfare and happiness of the people, but will also save very many of the thousands of pounds which are now paid out, unnecessarily, towards the upkeep of large general hospitals.—The Dental Science Journal of Australia, May 1923.

Weight and Height are not an Index of Nutrition: United States Public Health reports for January show that a study of weight and height measurements of nearly ten thousand children indicates that weight and height are not an index of nutrition. It is a little amusing to hear some of the self-appointed examiners in baby contests pronounce a verdict based upon weight and height when, as a matter of fact, many other things must be taken into consideration.—Journal of the Indiana State Medical Association, April 15, 1923.

Surgical Instrument Makers Charge War Prices: Most of the manufacturers of surgical instruments and supplies used by physicians evidently do not know that the war is over, for they still continue to charge war prices. It was an easy thing to double or triple the prices on the plea that there was a scarcity of labor and material due to the demands of war, and after once receiving inflated prices it has been difficult to get out of the habit. In consequence we are still paying what seems to be unnecessarily high prices for everything.—Journal of the Indiana State Medical Association, April 15, 1923.

"Teeth Marks Clue": According to the Sunday Chronical, youths who broke into Hamstel School, Southend, ransacked the teachers' desks in one of which was a soap-apple. It was found that somebody had made a big bite at this "apple."

Suspicion fell upon a lad named Arthur Frost, and a detective took an impression of the teeth marks, which corresponded with the bite on the "apple." Eventually the lad made a confession. He and a companion, Eric Nicholls, were both fined by the Southend Bench.—The Dental Surgeon, May 19, 1923.



High Level Bridge at Cleveland, Ohio.

American Dental Association, Cleveland, Ohio, September 10 to 14.

PROGRAM OF GENERAL SESSIONS[1]

TO BE HELD IN

CLEVELAND, OHIO, SEPTEMBER 10, 11, 12, 13, 14, 1923

TUESDAY MORNING, SEPTEMBER 11

9:45 A. M.

FIRST GENERAL SESSION

(Arena, Public Hall)

Organ Recital.....9:40 to 10:00 A. M.
Dr. W. H. O. McGehee....Cleveland, Ohio

Invocation
Right Reverend Joseph Schrembs, Bishop of Cleveland.

Vocal Selections
Doctor and Mrs. Carl S. Emmert.....
.....Cleveland, Ohio

Address of Welcome on behalf of the State of Ohio
By Cyrus Locher, Director of Commerce, representing Governor Donahey.

Address of Welcome on behalf of the City of Cleveland
By Fred Kohler, Mayor.

Address of Welcome on behalf of the Cleveland Chamber of Commerce
By Richard F. Grant, President.

Address of Welcome on behalf of Western Reserve University
By Robert E. Vinson, President.

Address of Welcome on behalf of the Cleveland Dental Society and presentation of gavel to President Buckley, on behalf of the Local Arrangements committee
By Dr. Frank M. Casto.

Response to Addresses of Welcome
By Sheppard W. Foster.....Atlanta, Ga.

Introduction of Distinguished Visitors.

President's Address
By John P. Buckley.....Los Angeles, Cal.

Exit March.

TUESDAY EVENING, SEPTEMBER 11

8:00 P. M.

SECOND GENERAL SESSION

(Arena, Public Hall)

The Cancer Problem
By Geo. W. Crile.....Cleveland, Ohio

The Dental Educational Problem
By Wm. J. Gies.....New York, N. Y.
Discussed by Wm. H. G. Logan....
.....Chicago, Ill.
and
H. E. Friesell .....Pittsburgh, Pa.

WEDNESDAY EVENING, SEPTEMBER 12

8:00 P. M.

THIRD GENERAL SESSION

(Arena, Public Hall)

"The Teeth and the Public"
By Royal S. Copeland, M.D., M.A., F.A.C.S., United States Senator from New York.

Dr. Royal S. Copeland was born at Dexter, Michigan, November 7, 1868. Graduated from the Dexter High School. Attended Michigan State Normal College, and the University of Michigan. From the last named institution he received the degree of Doctor of Medicine in 1889.

He was Mayor of Ann Arbor, Michigan, and held numerous civic offices while a resident of Ann Arbor. In 1908 he became Dean of Flower Hospital Medical College. Mayor Hylan appointed him Commissioner of Health of New York City. At Syracuse, N. Y., in 1922 he received at the hands of the Democratic State Convention the nomination of United States Senator and at the general election in November was elected to the United States Senate to succeed Hon. William M. Calder.

"The Dentist's Duty as a Citizen"
By Henrik Shipstead, D.D.S., United States Senator from Minnesota.

Dr. Henrik Shipstead was born in the township of Burbank, Kandiyohi County, Minnesota, on the 8th day of January, 1881. He attended the public school at New London, Minnesota, State Normal at St. Cloud and the Dental School of Northwestern

[1]The completed section programs, clinics and announcements, together with specific information regarding hotels, transportation, etc., has been published in the July Journal.

University, Chicago, graduating in 1903. He practiced dentistry in Glenwood, Minn., where he served one term as Mayor, also serving on the Charter Commission. Was a member of the state legislature during the 1917 session. Was candidate for the United States Senate on the Farmer-Labor ticket for 1923 and was elected over Frank B. Kellogg, Republican and Anna D. Oleson, Democrat, with a plurality of 85,000 votes. He enjoys the distinction of being the first dentist ever elected a United States Senator.

THURSDAY EVENING, SEPTEMBER 13

8:00 P. M.

FOURTH GENERAL SESSION

(Keith's Palace—The finest theater in the World)

Address by Honorable Newton D. Baker, Former Secretary of War of United States.....Cleveland, Ohio

This will be a joint meeting staged by the Program and Entertainment Committees.

AMERICAN DENTAL ASSOCIATION SIXTY-FIFTH ANNUAL MEETING

CLEVELAND, OHIO, SEPTEMBER 10 14, 1923

OFFICIAL CALL

To the Officers and Members of the American Dental Association:

The sixty-fifth annual meeting of the American Dental Association will be held at Cleveland, Ohio, September 10-14, 1923.

The House of Delegates will convene at 10:00 A. M. and 2:30 P. M., Monday, September 10, in the Assembly Room, Hollenden Hotel. All subsequent meetings will be held in the same place.

In the House[1] the representation of the various constituent societies for 1923 is as follows:[2]

Alabama	2
Alaska	1
Arizona	1
Arkansas	2
Army Dental Corps	1
California State	6
Southern California	6
Colorado	3
Connecticut	4
Cuba	1
Delaware	1
District of Columbia	2
National Capital	1
Florida	2
Georgia	3
Hawaiian Islands	1
Idaho	1
Illinois	16
Indiana	7
Iowa	6
Kansas	4
Kentucky	3
Louisiana	2
Maine	2
Maryland	2
Massachusetts	7
Michigan	6
Minnesota	7
Mississippi	2
Missouri	6
Montana	2

[1] "Sec. 2.—The total voting membership in the House of Delegates, exclusive of the Board of Trustees, shall be as follows: One delegate shall be allowed from each scientific section, from the Army Dental Corps, from the Navy Dental Corps, and one from each constituent society. Each constituent society shall be entitled to one additional delegate if one hundred of its members become regularly enrolled as members of the American Dental Association; and one more delegate for each additional two hundred members enrolled.

Explanatory.—Regardless of enrollment in the American Dental Association, each constituent society would have one delegate.

With 100 members in the American, two delegates.

With 300 members in the American, three delegates.

With 500 members in the American, four delegates.

With 700 members in the American, five delegates.

With 900 members in the American, six delegates.

With 1100 members in the American, seven delegates.

With 1300 members in the American, eight delegates.

With 1500 members in the American, nine delegates."—Constitutional and Administrative By-Laws, Article V, Sec. 2.

[2] This roll will be officially revised August 10, 1923.

Navy Dental Corps	1
Nebraska	4
Nevada	1
New Hampshire	1
New Jersey	6
New Mexico	1
New York	16
North Carolina	3
North Dakota	2
Ohio	9
Oklahoma	3
Oregon	2
Pennsylvania	11
Philippine Islands	1
Rhode Island	2
South Carolina	2
South Dakota	2
Tennessee	4
Texas	5
Trustees[3]	
Utah	2
Vermont	1
Virginia	3
Washington	4
West Virginia	3
Wisconsin	6
Wyoming	1

[3]"The Trustees shall be members of the House of Delegates, without the right to vote."—Constitutional and Administrative By-Laws, Article V, Section 1.

The general meeting, which constitutes the opening exercises of the Association, will be held Tuesday morning, September 11, at 9:45 A. M., Arena, Public Hall. The various sections of the American Dental Association will meet Tuesday, September 11, at 2:00 P. M. and subsequently according to their respective programs. (See July Journal.)

The Registration Department will be open from 8:30 A. M. until 5:00 P. M. on Monday, Tuesday, Wednesday, Thursday, September 10, 11, 12, and 13, and from 8:30 A. M. to 10:00 on Friday, September 14.

The Registration Office will be in the Foyer of the Cleveland Public Hall.

JOHN P. BUCKLEY, *President,*
OTTO U. KING, *General Secretary.*

MEMBERS OF THE HOUSE OF DELEGATES, 1923

A Preliminary Roster of the Legislative Body of the American Dental Association

DELEGATES AND ALTERNATES

The list of members of the House of Delegates for the session is incomplete, as a few of the state societies are yet to hold their meetings at which delegates will be elected.

ALABAMA

Delegates

J. A. Blue, Birmingham
H. C. Hassell, Tuscaloosa

Alternates

C. F. Chandler, Montgomery
C. F. Dillard, Huntsville

ALASKA

Delegates

Alternates

ARIZONA

Delegates

H. H. Braxton, Phoenix

Alternates

Eugene McGuire, Phoenix

ARKANSAS

Delegates

T. J. Newman, Boyle Bldg., Little Rock
J. D. Jordan, Boyle Bldg., Little Rock

Alternates

G. C. Jernigan, Rector
C. U. Mayfield, Pine Bluff

ARMY DENTAL CORPS

Delegates

Frank P. Stone, Lieutenant-Colonel, Medical Field Service School, Carlisle Barracks, Pa.

Alternates

Wm. S. Rice, Major, Sixth Corps Area Headquarters, Chicago, Ill.

CALIFORNIA

Delegates

Frank C. Pague, 209 Post St., San Francisco
A. W. Ward, 209 Post St., San Francisco
Hugh Avary, Head Bldg., San Francisco
James Allen Graham, 209 Post St., San Francisco
John E. Gurley, 350 Post St., San Francisco
B. Frank Gray, 209 Post St., San Francisco

Alternates

O. S. Dean, First National Bank Bldg., Oakland

SOUTHERN CALIFORNIA

Delegates

W. H. Spinks, 910 Security Bldg., Los Angeles
Lewis E. Ford, 634 So. Western Ave., Los Angeles
C. M. Benbrook, 707 Auditorium Bldg., Los Angeles
R. R. Hartley, 1009 Brockman Bldg., Los Angeles
C. E. Rice, 1006 Story Bldg., Los Angeles
F. A. Giguette, 307 Dodworth Bldg., Pasadena

Alternates

J. Elton Lang, 915 Van Nuys Bldg., Los Angeles
C. G. Hartley, 1009 Brockman Bldg., Los Angeles
C. O. McBean, Hollingsworth Bldg., Los Angeles
G. M. Hollenback, 1008 Union Bank Bldg., Los Angeles
J. F. Cook, 1001 Merchants National Bank Bldg., Los Angeles
Bert Boyd, 1010 Story Bldg., Los Angeles

COLORADO

Delegates

W. T. Chambers, Metropolitan Bldg., Denver
E. R. Warner, Metropolitan Bldg., Denver
C. S. Kramer, M. W. A. Sanatorium, Woodmen

Alternates

H. W. Wilson, Imperial Bldg., Denver
E. E. Bailey, Metropolitan Bldg., Denver
Geo. R. Warner, California Bldg., Denver

CONNECTICUT

Delegates

Arthur B. Holmes, Waterbury
Edward S. Gaylord, New Haven
Morton J. Loeb, New Haven

Alternates

George S. B. Leonard, Mystic
Frederick T. Murliess, Jr., Hartford
Albert W. Crosby, New Haven

CUBA

Delegates

Alternates

DELAWARE

Delegates

G. A. Hitch, Laurel

Alternates

P. H. Keavenly, 922 Jefferson St., Wilmington

DISTRICT OF COLUMBIA

Delegates

Mark F. Finley, 1928 "I" St., N. W., Washington

Thos. J. Rice, 921 15th St., N. W., Washington

Alternates

E. Clyde Shade, 921 15th St., N. W., Washington

Arthur B. Crane, 921 15th St., N. W., Washington

NATIONAL CAPITAL

Delegates

E. A. Bryant, 921 15th St., N. W., Washington

Alternates

C. Willard Camalier, 921 15th St., N. W., Washington

FLORIDA

Delegates

D. B. Tiston, Gainesville

C. J. Caraballo, Tampa

Alternates

R. C. Harrell, Havana

G. D. Young, St. Augustine

GEORGIA

Delegates

N. G. Slaughter, Athens

R. H. Calhoun, Augusta

DeLos L. Hill, Atlanta

Alternates

M. D. Huff, Atlanta

R. R. Byrnes, Atlanta

S. W. Foster, Atlanta

HAWAIIAN ISLANDS

Delegates

Alternates

IDAHO

Delegates

Alternates

ILLINOIS

Delegates

J. H. Prothero, 22 E. Washington St., Chicago

A. E. Converse, Springfield

Arthur G. Smith, 511 Central National Bank Bldg., Peoria

P. A. Pyper, Pontiac

E. F. Hazell, 608 E. Capitol Ave, Springfield

W. F. Whalen, 906 Lehmann Bldg., Peoria

P. B. D. Idler, 30 No. Michigan Ave., Chicago

Howard S. Layman, Leland Bldg., Springfield

Richard H. Daniels, 909 Lehmann Bldg., Peoria

W. A. McKee, Benton

C. N. Johnson, 22 E. Washington St., Chicago

V. P. Perisho, 221 E. Main St., Streator

J. F. F. Waltz, 345 No. Main St., Decatur

Harold S. Smith, 1010 Belmont Ave., Chicago

L. W. Strong, 30 No. Michigan Ave., Chicago

W. F. Schmeckebier, 25 Illinois St., Chicago Heights

A. C. Willman, Kankakee

Alternates

G. G. Knapp, 1203 W. Garfield Blvd., Chicago

J. Clark Waddell, 501 Missouri Ave., East St. Louis

J. C. Black, Del Prado Hotel, Chicago

B. H. Bigelow, 501 Trust Bldg., Rockford

O. J. Jarrett, Peoples Bank Bldg., Bloomington

C. L. Snyder, 505 Second National Bank Bldg., Freeport

Harry B. Pinney, 108 No. State St., Chicago

J. H. Cadmus, 1417 Marshall Field Annex, Chicago

E. D. Coolidge, 25 E. Washington St., Chicago

G. Walter Dittmar, 59 E. Madison St., Chicago

M. M. Printz, 25 E. Washington St., Chicago

B. S. Partridge, 1230 E. 63rd St., Chicago

H. A. Moreland, Cairo

George N. West, 32 No. State St., Chicago

T. P. Donelan, DeWitt-Smith Bldg., Springfield

H. R. H. Brevig, 3329 W. Fullerton Ave., Chicago

Frank J. Ryan, 216 So. Troy St., Chicago

INDIANA

Delegates

W. E. Neuenschwander, Fort Wayne

F. R. Henshaw, Indianapolis

H. C. McKittrick, Indianapolis

A. R. Ross, Lafayette

C. R. Jackson, Indianapolis

C. E. Redmon, Peru

P. N. Chadwick, Rushville

Alternates

Harry Shields, Brownstown

Ray Kibler, Indianapolis

A. B. Price, Richmond

W. O. Vallette, Goshen

J. M. Hale, Mt. Vernon

J. B. Carr, Indianapolis

C. A. Priest, Marion

IOWA

Delegates

J. A. Bliss, Sioux City

Earle S. Smith, Iowa City

John G. Hildebrand, Waterloo

Clarence V. Watts, Des Moines

J. H. Calder, Cedar Rapids

L. W. Snuggins, Des Moines

Alternates

J. F. Walter, McGregor

R. W. Noland, 626 Fleming Bldg., Des Moines

H. A. True, 801 Hubble Bldg., Des Moines

KANSAS

Delegates

G. A. Crise, Manhattan
C. N. Mertz, Topeka
F. O. Hetrick, Ottowa
G. F. Burkett, Kingman

Alternates

Harry M. McFarland, Kansas City
C. A. Martin, Winfield
D. T. Parkinson, Wichita
J. W. O'Brien, Lawrence

KENTUCKY

Delegates

C. W. McGuair, Franklin
E. C. Hume, Louisville
I. H. Harrington, Louisville
O. B. Powell, Paducah

Alternates

M. B. Guthrie, Lexington
J. H. Gunkel, Newport
K. H. Justice, Cattlettsburg
W. G. Best, Berea

LOUISIANA

Delegates

Walter Leabo, Shreveport
J. P. Wahl, New Orleans

Alternates

R. H. Welsh, New Orleans
F. J. Wolfe, New Orleans

MAINE

Delegates

Fred S. Woods, Portland
Gerald P. Clifford, Portland

Alternates

E. A. Sheehy, Rumford
W. H. Thompson, Portland

MARYLAND

Delegates

E. W. Swinehart, Professional Bldg., Baltimore
Horace M. Davis, Professional Bldg., Baltimore

Alternates

Karl Heintz, Cumberland
R. O. Higgins, Salisbury

MASSACHUSETTS

Delegates

Frank P. Barnard, 507 Main St., Worcester
Frank H. Dean, 311 Main St., Worcester
Thomas K. Ross, 280 Main St., Fitchburg
Murdock C. Smith, 3 Lee Hall, Lynn
Harold Crowell, 23 Central St., Lynn
Charles M. Proctor, 19 Bay State Road, Boston
Walter G. Bridge, 416 Huntington Ave., Boston
Carl R. Lindstrom, 520 Beacon St., Boston

Alternates

Fred E. Jeffrey, 219 Essex St., Salem
Leon Storz, 507 Main St., Worcester
Wm. H. Eaton, 419 Boylston St., Boston
David F. Spinney, 1330 Beacon St., Boston
J. H. Pemberton, Fall River
F. O. Kidd, Fall River

MICHIGAN

Delegates

C. J. Lyons, Ann Arbor
P. R. Glass, Saginaw
C. G. Bailey, Lansing
G. C. Bowles, Detroit
E. O. Gillespie, Detroit
J. H. Taylor, Flint

Alternates

C. G. Parker, Detroit
J. A. Connery, Saginaw
C. A. Burbridge, Grand Rapids
F. W. Hawlett, Jackson
W. W. Gibson, Grand Rapids
B. F. Miller, Jr., Flint

MINNESOTA

Delegates

H. B. Washburn, 2395½ University Ave., St. Paul
H. G. Keyworth, Rice & University, St. Paul
F. E. Cobb, 601 Donaldson Bldg., Minneapolis
C. H. Turnquist, 338 LaSalle Bldg., Minneapolis
E. D. Bettenhausen, 237 Fargusson Bldg., Duluth
Boyd S. Gardner, Rochester
C. G. Gillan, Austin

Alternates

J. B. Kohagen, 500 Fidelity Bldg., Duluth
H. J. MacKechnie, Hibbing
F. A. Bricker, Rochester
J. W. S. Gallagher, Winona
Benjamin Sandy, 636 Syndicate Bldg., Minneapolis
V. D. Irwin, 201 Fargusson Bldg., Duluth
A. L. Bruener, 338 LaSalle Bldg., Minneapolis

MISSISSIPPI

Delegates

W. R. Wright, Jackson
J. F. Brunson, Meridian

Alternates

N. L. Swayze, Yazoo
R. S. Neyland, Jackson

MISSOURI

Delegates

George Haigh, Jefferson City
George Winter, Frisco Bldg., St. Louis
T. H. Tye, Cameron
Y. E. Masterson, Lathrop Bldg., Kansas City
W. M. Bartlett, Wall Bldg., St. Louis
R. J. Rinehart, Bryant Bldg., Kansas City
F. C. Rodgers, Wall Bldg., St. Louis

Alternates

C. B. Coleman, Poplar Bluff
H. Boatner, Landers Bldg., Springfield
R. M. Siebel, Bryant Bldg., Kansas City
C. W. Digges, Columbia
E. H. Westenhaver, Lathrop Bldg., Kansas City
E. P. Brady, 29th & Locust Sts., St. Louis
J. P. Harper, 3554 Caroline Ave., St. Louis

MONTANA

Delegates

Alternates

NAVY DENTAL CORPS

Delegates

Geo. H. Reed, Lieutenant-Commander, Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

Alternates

Lucian C. Williams, Lieutenant-Commander, Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

NEBRASKA

Delegates

E. H. Bruening, 1129 First National Bank Bldg., Omaha
C. E. Brown, 620 Terminal Bldg., Lincoln
H. E. King, 546 Peters Trust Bldg., Omaha

Alternates

G. A. Grubb, Ganter Block, Lincoln
M. E. Vance, Ganter Block, Lincoln
M. H. Dunham, 1100 First National Bank Bldg., Omaha

NEVADA

Delegates

John V. Ducey, Reno

Alternates

Thomas H. Suffall, Reno

NEW HAMPSHIRE

Delegates

Arthur A. Blondin, Manchester

Alternates

E. D. Forrest, Tilton

NEW JERSEY

Delegates

S. Irving Callahan, Woodstown
W. H. Gelston, 40 No. 30th St., Camden
W. W. Hodges, 175 Smith St., Perth Amboy
R. S. Hopkins, 913 Broad St., Newark
F. H. Lum, Jr., Fairmont Ave., Chatham
M. C. Pearce, 310 Main St., Orange

Alternates

E. C. Stillwell, 71 Winsor Place, Glen Ridge
A. R. Slade, 25 High St., Millville
Louis F. Kuntz, 180 Smith St., Perth Amboy
John A. Voorhees, 32 Eppirt St., East Orange
C. E. C. Smith, 15 South St., Newark
James P. Hagerty, 34 Wallace Place, Newark

NEW MEXICO

Delegates

Chas. A. Eller, Albuquerque

Alternates

D. P. Nolting, Albuquerque

NEW YORK

Delegates

Alfred Walker, 100 W. 59th St., New York
Frank A. Gough, 184 Joralemon St., Brooklyn
A. N. Wright, Troy
A. C. Rich, Saratoga
A. R. Cook, University Block, Syracuse
John Howe, Ithaca
Edward G. Link, Cutler Bldg., Rochester
Louis Meisburger, 85 No. Pearl St., Buffalo
A. W. Twiggar, Ossining
A. P. Burkhart, Auburn
D. H. Squire, 37 Allen St., Buffalo
W. C. Fisher, 9 Maple St., Brownville
C. C. Linton, 40 E. 41st St., New York
Horace P. Gould, 184 Joralemon St., Brooklyn

Alternates

Martin Dewey, 501 Fifth Ave., New York
T. P. Hyatt, 576 Fifth Ave., New York
G. A. Vanderpool, Albany
L. A. Timmerman, Amsterdam
G. B. Beach, S. A. & K. Bldg., Syracuse
Fred Howe, Ithaca
W. W. Smith, East Ave., Rochester
A. Hoffman, 381 Linwood Ave., Buffalo
Stephen Palmer, Poughkeepsie
C. M. Dunne, Norwich
W. F. Chappelle, 131 Allen St., Buffalo
W. N. Frazer, 184 McDonough St., Brooklyn
T. R. Cullen, Oswego
G. G. Burns, Professional Bldg., Rochester

NORTH CAROLINA

Delegates

F. L. Hunt, Asheville
Charles L. Alexander, Charlotte
Conrad Watkins, Winston-Salem

Alternates

E. J. Tucker, Roxboro
D. F. Keel, Greensboro
J. S. Spurgeon, Hillsboro

NORTH DAKOTA

Delegates

R. S. Towne, Bismarck
C. F. Sweet, Minot

Alternates

A. Hallenberg, Fargo
Tom Smith, Langdon

OHIO

Delegates

H. M. Semans, No. Park St., Columbus
J. F. Stephan, 1122 Guardian Bldg., Cleveland
L. P. Bethel, 185 E. State St., Columbus
F. M. Casto, 458 Rose Bldg., Cleveland

G. C. Nixon, Mah. National Bank Bldg., Youngstown
C. W. Mills, Chillicothe
C. H. Schott, 1004 Neave Bldg., Cincinnati
W. A. Price, 8926 Euclid Ave., Cleveland
Harry Cope, 328 E. State St., Columbus

Alternates

W. H. Hayden, 228 Lincoln Ave., Youngstown
G. D. Edgar, Defiance
E. S. Braithwaite, Willard
Howard Williamson—
J. K. Douglas, Sandusky
E. L. Pettibone, 6503 Detroit Ave., Cleveland
J. J. Welker, 1143 Ohio Bldg., Toledo
T. I. Way, 52 Groton Bldg., Cincinnati

OKLAHOMA

Delegates

C. R. Lawrence, Enid
C. L. White, Oklahoma City
L. L. Barnes, Oklahoma City

Alternates

A. E. Bonnell, Muskogee

OREGON

Delegates

Herbert C. Miller, North Pacific Dental College, Portland
David B. Hill, Pendleton

Alternates

Wallace C. Shearer, Stevens Bldg., Portland
Chas. H. Walwrath, North Pacific Dental College, Portland

PENNSYLVANIA

Delegates

W. L. Fickes, East End Savings & Trust Bldg., Pittsburgh
E. R. Sausser, 225 So. 15th St., Philadelphia
A. H. Reynolds, 4630 Chester Ave., Philadelphia
R. H. D. Swing, 1623 Walnut St., Philadelphia
W. J. Robinson, 4906 Walnut St., Philadelphia
O. J. Specker, 51 No. 4th St., Reading
L. P. Anthony, 211 So. 12th St., Philadelphia
W. J. McKinley, Weightman Bldg., Philadelphia
D. S. Gardner, Dime Bank Bldg., Scranton
H. E. Friesell, 1206 Highland Bldg., Pittsburgh
P. V. McParland, 706 Highland Bldg., Pittsburgh
J. C. Nugent, Altoona
A. C. Barclay, 914 Highland Bldg., Pittsburgh
W. E. Mendell, 405 E. Ohio St., Pittsburgh

Alternates

G. S. Schlegel, 147 No. 8th St., Reading
A. C. Young, Highland Bldg., Pittsburgh
A. P. Lee, 1616 Locust St., Philadelphia
R. E. Black, Huntington
L. Waddill, Jenkins Arcade Bldg., Pittsburgh
S. B. Luckie, Chester
H. M. Kirkpatrick, 214 No. 2nd St., Harrisburgh
J. A. Standen, 1629 Spruce St., Philadelphia
H. L. Wagner, Altoona
W. A. McCready, Highland Bldg., Pittsburgh
A. Kassab, Chester
J. G. Logan, Portage
J. R. Cameron, 1419 Spruce St., Philadelphia
F. D. Miller, Altoona

PHILIPPINE ISLANDS

Delegates

Alternates

RHODE ISLAND

Delegates

Herbert P. Beckett, 301 Butler Exchange, Providence
Joseph P. Massicotte, Post Office Bldg., Olneyville

Alternates

William R. Burke, 171 Westminster St., Providence
Frank P. Duffy, Riverpoint

SOUTH CAROLINA

Delegates

J. P. Glenn, Spartanburg
Geo. W. Dick, Sumter

Alternates

E. A. Earley, Darlington

SOUTH DAKOTA

Delegates

T. C. Bonney, Aberdeen
G. O. Goodman, Milbank

Alternates

Robert Jasman, Sioux Falls
H. L. Eggers, Sioux Falls

TENNESSEE

Delegates

O. A. Oliver, Nashville
F. W. Meacham, Hamilton National Bank Bldg., Chattanooga
G. L. Powers, Bank of Commerce Bldg., Memphis

Alternates

R. Boyd Bogle, Hitchcock Bldg., Nashville
J. G. McDowell, Hitchcock Bldg., Nashville
J. D. Towner, 1206 Exchange Bldg., Memphis

TEXAS

Delegates

A. L. Frew, 4105 Live Oak Ave., Dallas
J. O. Hall, Waco
J. M. Murphy, Temple
W. O. Talbot, Fort Worth
Bush Jones, 401 Linz Bldg., Dallas

Alternates

C. D. Wofford, Plainview
J. G. Fife, 1813 Main St., Dallas
W. H. Scherer, Houston
W. D. McCarty, San Antonio
Geo. H. Mengel, El Paso

TRUSTEES

Waldo E. Boardman, (deceased), 419 Boylston St., Boston, Mass.
J. F. Biddle, 517 Arch St., Pittsburgh, Pa.
Carl D. Lucas, 902 Hume-Mansur Bldg., Indianapolis, Ind.
R. H. Volland, Iowa City, Iowa
C. C. Allen, Tenth & Troost, Kansas City, Mo.
John D. Millikin, Elkan-Gunst Bldg., San Francisco, Cal.
Thomas P. Hinman, Fourth National Bank Bldg., Atlanta, Ga.
H. J. Burkhart, Box 35, East Ave., P. O., Rochester, N. Y.
C. W. Hall, Alhambra Bldg., Milwaukee, Wis.

UTAH

Delegates

R. E. Wight, Boston Bldg., Salt Lake City
Victor H. Sears, Clift Bldg., Salt Lake City

Alternates

W. A. Squires, Boston Bldg., Salt Lake City
Hyrum Bergstrom, Walker Bank Bldg., Salt Lake City

VERMONT

Delegates

O. S. Nims, Burlington

Alternates

Fred R. Newell, Brattleboro

VIRGINIA

Delegates

J. A. C. Hoggan, Professional Bldg., Richmond
M. B. Rudd, Methodist Pub. Bldg., Richmond
R. F. Simmons, Taylor Bldg., Norfolk

Alternates

R. L. Simpson, 301 E. Franklin St., Richmond
W. N. Hodgkin, Warrenton
J. G. Jackson, Monroe Bldg., Norfolk

WASHINGTON

Delegates

Claude J. Stansbery, Joslina Green, Seattle
J. E. Argue, 800 Cobb Bldg., Seattle
F. H. Herbert, Cobb Bldg., Seattle
C. H. Libbey, Masonic Temple, Yakima
A. L. Martin, Green Bldg., Seattle

WEST VIRGINIA

Delegates

W. S. Rosenheim, Williamson
I. J. Kail, Huntington
C. H. Neill, Fairmont

Alternates

A. E. Hennen, Wheeling
F. M. Farnsworth, Buckhannon
Basil Herron, Fairmont

WISCONSIN

Delegates

W. H. Cudworth, 128 Wisconsin St., Milwaukee
A. G. Fee, Superior
T. A. Hardgrove, Fond du Lac
H. L. Banzhaf, 140 16th St., Milwaukee
Wm. Kettler, 306 North Ave., Milwaukee
P. W. Rood, Majestic Bldg., Milwaukee

Alternates

J. L. Blish, Fond du Lac
W. I. Macfarlane, Tomahawk
E. A. Geilfuss, Goldsmith Bldg., Milwaukee
O. G. Krause, Wells Bldg., Milwaukee
E. C. Oviatt, Columbus
S. H. Chase, Madison

WYOMING

Delegates

J. A. Farlien, Worland

Alternates

F. M. Booth, Lovell

Announcements

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Dental Association, September 10-14, 1923, Cleveland, Ohio.

American Child Health Association, October 15, 16 and 17, 1923, Detroit, Michigan.

American Academy of Periodontology, September 7 and 8, 1923, Statler Hotel, Cleveland, Ohio.

American Society of Oral Surgeons and Exodontists, September 4 to 7, 1923, Cleveland, Ohio.

American Society of Dental Radiographers, September 7 and 8, 1923, Cleveland, Ohio.

American College of Surgeons, October 22 to 26, 1923, Congress Hotel, Chicago, Illinois.

Congress of Anesthetists, October 22 to 24, 1923, Auditorium Hotel, Chicago, Illinois.

Federation of American Women Dentists, September 10-14, 1923, Cleveland, Ohio.

National Alumni Chapter, Psi Omega Fraternity, September 10, 1923, Cleveland Hotel, Cleveland, Ohio.

National Board of Dental Examiners, September 10 and 11, Lattice Room, Hotel Statler, Cleveland, Ohio.

National Society of Denture Prosthetists, August 27 to September 8, 1923, Cleveland, Ohio.

Research Commission of the American Dental Association, September 8, at 10 A. M. and 8:30 P. M., Hollenden Hotel, Cleveland, Ohio.

Xi Psi Phi, September 7 and 8, 1923, Cleveland, Ohio. Headquarters, Winton Hotel.

National Alumni Chapter, Xi Psi Phi, September 10, Winton Hotel, Cleveland, Ohio.

Delta Sigma Delta Fraternity, September 10, 1923, Cleveland, Ohio. Headquarters, Statler Hotel.

STATE SOCIETIES

National Capital, first Tuesday of every month.

September

Delaware, at Wilmington (12).

October

Northern Indiana, at Goshen (15, 16).

November

Arizona, at Chandler (2, 3).
Florida, at Jacksonville (8, 9, 10).
Georgia, at Athens (7, 8, 9).

January (1924)

Chicago Dental Society, at Chicago (17, 18, 19).

May (1924)

Pennsylvania, at Pittsburgh (13, 14, 15).

MEETINGS OF STATE BOARD OF DENTAL EXAMINERS

Colorado, at Denver, first Tuesday of December. Secretary, Wm. H. Flint, Littleton, Colorado.

NORTHERN INDIANA DENTAL SOCIETY

The thirty-fourth annual meeting of the Northern Indiana Dental Society will be held at Goshen, October 15 and 16, 1923.

F. B. GARNER, *President*,
Goshen, Indiana.

CHICAGO DENTAL SOCIETY

The annual clinic and meeting of the Chicago Dental Society will be held at the Hotel Drake, January 17, 18 and 19, 1924. Please address the undersigned for further information.

M. M. PRINTZ, *Secretary*,
25 E. Washington St., Chicago.

PENNSYLVANIA STATE DENTAL SOCIETY

The fifty-sixth annual meeting of the Pennsylvania State Dental Society will be held in the Syria Mosque, Pittsburgh, Pennsylvania, on May 13, 14 and 15, 1924.

LESLIE WADDILL,
Chairman of Exhibits.

THE SUSQUEHANNA DENTAL ASSOCIATION OF PENNSYLVANIA

The Susquehanna Dental Association of Pennsylvania, will hold its sixtieth annual meeting at Hotel Bethlehem. Bethlehem, Pennsylvania, October 17, 18 and 19, 1923.

GEORGE C. KNOX,
Recording Secretary,
Middletown, New York.
R. M. WALLS,
Chairman of the Executive Committee,
Bethlehem, Pennsylvania.

NATIONAL ALUMNI CHAPTER OF THE PSI OMEGA FRATERNITY

The annual meeting of the National Alumni Chapter of the Psi Omega Fraternity will be held at the Cleveland Hotel, Cleveland, Ohio, Monday, September 10. The Executive Committee will meet at 10 A. M. The general meeting will start at 2 P. M. and everyone is urged to be on hand promptly. A most interesting meeting is planned. During this meeting the ladies will be taken for an automobile ride. An informal banquet with the ladies present will be held at 7 P. M. for which reservations must be made by 4 P. M. Many surprises are in store for those who attend.

MAX WASSMAN, JR.,
Grandmaster National Alumni Chapter.

FEDERATION OF AMERICAN WOMEN DENTISTS

The Federation of American Women Dentists will hold its third annual meeting in Cleveland, Ohio, September 10 to 14, 1923, concurrent with the meeting of the American Dental Association. A cordial invitation to join is extended to all women members of the American Dental Association.

STELLA RISSER, *Secretary,*
Union National Bank Bldg.,
Houston, Texas.

PRIZES DONATED FOR AMERICAN DENTAL ASSOCIATION TRAP SHOOTING TOURNAMENT

The Antidolor Mfg. Co., Springville, N. Y.—Complete Nerve Blocking Outfit, with complete Nerve Blocking Book of instructions.

Blue Island Specialty Co., Blue Island, Ill.— Revolving Bur Stand with Assortment of Excavating Burs.

A. A. Brown Dental Mfg. Co., St. Louis, Mo.—One dozen boxes Neo-Balsam Compound.

The Engeln Electric Co., Cleveland, Ohio.—Blum Binocular Dentascope.

The W. V-B. Ames Co., Fremont, Ohio.—$15.00 package Ames Crown & Bridge Cement.

The Hugo Friedman Co., Chicago, Ill.—Set of 8 Prophylactic Scalers, One Pocket Knife and a "Henahan Elevator."

Friedman Specialty Co., Chicago, Ill.—One Skull Ink Well; One Fracture Set.

The Toledo Dental Supply Co., Toledo, Ohio.—1 gross Diamond Burs, well assorted. 1 Bottle Diamond Deodorizer & Sprayer.

The Ransom & Randolph Co., Cleveland, Ohio.—1 gross Cutwell Burs in Turret Case.

The Abbott Laboratories, Chicago, Ill.—5 Popular Dental Items in plush lined case.

Novocol Chemical Mfg. Co., Inc., Brooklyn, N. Y.—10 tubes Novol Procaine Tablets No. 1; 1 Novol Ringer Flask; 1 tube Novesthol Paste; 1 bottle Novesthol Liquid; 1 bottle Validol (Novol); 1 tube Bromural Tablets.

Columbia X-Ray & Electric Corp., New York City, N. Y.—Columbia Electric Pulp Tester.

Kress & Owen Co., New York City, N. Y.—Hospital Size bottle Glyco-Thymoline.

Cleveland Dental Mfg. Co., Cleveland, Ohio.—1 set 16 Crandall Amalgam Condensers.

Frank S. Betz Co., Hammond, Ind.—1 Brandeis Crown Slitter.

Colgate & Co., New York City, N. Y.—1 Men's Gift Box.

Thwaites X-Ray Co., Grand Rapids, Mich.—1 Gross X-Ray Films.

Curry Hand-Piece Protector Co., Baltimore, Md.—Outfit of Curry Hand-Piece Protectors and Glass Container for same.

Lee S. Smith & Son Mfg. Co., Pittsburgh, Pa.—1 Pair Porcelain Enamel Chair Arms (Forsythe type).

The S. S. White Dental Mfg. Co., Philadelphia, Pa.—1 $50.00 Cabinet New Filling Porcelain.

J. W. Ivory, Philadelphia, Pa.—Set of Ivory Clamps in Oak Case.

Manhattan Coat Factory, Chicago, Ill.—1 Poplin Garment—made to order.

The L. D. Caulk Co., Milford, Delaware.—1 Ten Shade Full Portion Package of De-Trey's Synthetic Porcelain.

The Heidbrink Co., Minneapolis, Minn.—Set of Bite Blocks & Set of Mouth Props.

Brophy Dental Mfg. Co., Chicago, Ill.—1 Set Window Casting Rings.

Industrial Rubber Corporation, Long Island City, N. Y.—1 Dozen Cleanlyke Caps and Discs.

Union Dental Instrument Mfg. Co., Philadelphia, Pa.—Set of 18 Udimcolite Instruments.

Lavoris Chemical Co., Minneapolis, Minn.—Cup.

Corega Chemical Co., Cleveland, Ohio.—Order for Merchandise to the Value of $25.00.

The Alkalol Co., Taunton, Mass.—

The Halle Bros. Co., Cleveland, Ohio.—Prize to be selected.

The Electro Dental Mfg. Co., Philadelphia, Pa.—Electro Dental Water Heater.

The May Co., Cleveland, Ohio.—$5.00 Merchandise Bond.

Thomas J. Dee & Co., Chicago, Ill.—5 ounces of Dee Alloy.

The Rich-Alloy Co., Cleveland, Ohio.—American Beauty Vase 19″ being made especially by the Roycrofters.

The Teter Mfg. Co., Cleveland, Ohio.—1 Cowhide Bag.

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